DEPARTMENT OF DEFENSE
IN-HOUSE RDT&E ACTIVITIES

FY2000

Management Analysis Report

Department of the Army
Department of the Navy
Department of the Air Force
DoD Agency (USUHS - AFRRI)

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a. NAME *(Last, First, Middle Initial)* Darby, Andrew (DTIC)	b. TELEPHONE NO. *(Include Area Code)* (703) 767-9128

5. PRIOR COORDINATION

a. NAME *(Last, First, Middle Initial)*	b. OFFICE/AGENCY	c. TELEPHONE NO. *(Include Area Code)*
Morrison, Walter F.	SAAL-TR - Army	(703) 617-0314
Payne, Thomas H.	ONR - Navy	(703) 696-0107
Ruck, Hendrick W.	SAF/AQR - Air Force	(703) 588-7780
Palmer, Ronald E.	AFRRI - USUHS	(301) 295-9252
Gehrig, John F.	DOT&E	(703) 578-8222
Foster, Beth	ODUSD S&T (P&P)	(703) 695-0005

6. REMARKS

This is an annual report published by DDR&E which includes facilities, personnel, program, and funding information on RDT&E Activities. It provides insight into the technical and organizational environment of the DoD Laboratories and the financial, manpower, and facility investments made in them.

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DEPARTMENT OF DEFENSE IN-HOUSE RDT&E ACTIVITIES

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DEPARTMENT OF DEFENSE IN-HOUSE RDT&E ACTIVITIES REPORT

for Fiscal Year 2000

Prepared for:

The Office of the Secretary of Defense
Director, Defense Research and Engineering
The Pentagon
Washington, DC 20301

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FOREWORD

Introduction

The DoD In-House Research, Development, Test & Evaluation (RDT&E) Activities Report was started in the mid-1960s by the Office of Laboratory Management within the Office of the Secretary of Defense, at the request of the then Director of Defense Research and Engineering (DDR&E), Dr. John Foster. The annual report has been produced in official form since 1966.

The DoD In-House RDT&E Activities Report is the DDR&E's central source of information on laboratory status, and serves four essential purposes:

(1) since inception, it has been the only compilation of statistics organized by location on DoD RDT&E Activities;
(2) it provides the basis for prompt responses to many general queries about DoD RDT&E Activities, without recourse to special surveys, etc.;
(3) it provides a historical database which can be utilized for tracing consolidations and organizational changes, and for special analyses; and
(4) it provides insight into the technical and organizational environment of the DoD Laboratories and the financial, manpower, and facility investments made in them.

The Director, Science and Technology Plans and Programs leads a Steering Group which is responsible for the preparation and oversight of the report and its underlying database. The Steering Group is composed of representatives from the offices of the Director of Defense Research and Engineering, Director, Operational Test & Evaluation, Deputy Assistant Secretary of the Army for Research and Technology, Chief of Naval Research, Deputy Assistant Secretary of the Air Force (Science, Technology and Engineering), and Director of the Armed Forces Radiobiology Research Institute of the Uniformed Services University of the Health Sciences (USUHS).

A DoD organizational entity is considered to be a "DoD RDT&E Activity" when it is owned and operated by the Government, and a minimum of 25% of its total effort is devoted to research, advanced technology development, engineering and manufacturing development, demonstration/validation, systems or operational support, or some combination thereof. Examples are a research laboratory; a research, development and engineering center (RDEC); a test center or proving ground; and a multi-functional entity such as a "warfare center." An "In-House" RDT&E Activity is an organization where a minimum of 25% of the in-house manpower and/or 25% of the obligational authority used is devoted to research, advanced technology development, engineering development, etc., conducted in-house.

Data in this report should not be summarized or used for comparative analyses between Activities and/or across Services because labs/centers use different business systems to satisfy their special needs. Organizational structures also differ. Some organizations (e.g., Navy) operate on an industrial funding basis; that is, they charge their customers for all operating costs, including maintaining their physical plants and providing other necessary support services (e.g., human resources office, finance and accounting support). Other labs/centers (e.g., Army/Air Force) are institutionally funded; that is, they receive most of their funding as direct

appropriations from Congress and use these funds for operating support costs as well as for research. Institutionally funded labs/centers may be tenants on larger military bases and receive their support services from those host bases, or they may be responsible for base operations and these support services (personnel and costs). Both are included in this report, as appropriate.

Structure of Report

Selected data for the In-House RDT&E Activities of the Army, Navy, Air Force and the USUHS are summarized in tables in the first section of the report. Following the tables are individual sections, which cover the In-House RDT&E Activities of the three Military Services and USUHS. Each Activity is described in a standard multi-page format.

Activities are listed alphabetically within their respective military departments. A partial organization chart, entitled "Abbreviated Functional Chart - Technical Organizations", appears for each Activity to provide an overview of its technical operations.

Funding data are broken down into the standard RDT&E sub-categories:

6.1 - Basic Research
6.2 - Applied Research
6.3 - Advanced Technology Development
6.4 - Demonstration & Validation
6.5 - Engineering and Manufacturing Development
6.6 - RDT&E Management Support
6.7 - Operational Systems Development
Non-DoD

All zero-filled report data fields reflect a zero amount reported.

Personnel data for the FY2000 report has been extracted, where possible, from 30 September 2000 data provided to the Defense Manpower Data Center (DMDC), by the Services.

Organizational changes for FY2000 appear in Appendix A. Appendix B contains definitions of the data elements displayed in this report. Appendix C defines selected abbreviations and acronyms.

Every effort has been made to provide accurate information. Each submission was reviewed and approved by the head of the reporting Activity. All numbers and statements submitted by each Activity were then thoroughly examined by the members and staff of the Steering Group. Please note that this report does not represent the total DoD RDT&E program. It is also not an accounting or financial management document, but rather a "snapshot" of the operation of the individual Activities contained in the report. All funding data reflect total obligational authority received in FY2000. See Appendix B for further explanations.

The report is used by numerous DoD organizations, as well as various committees of Congress, the Library of Congress and the General Accounting Office. The report provides easily accessible, comprehensive and accurate information without frequent querying of field Activities. In addition, this publication has proven helpful to those in the private sector

interested in exploring the potential for technology cooperation/transfer with DoD Laboratories (for example, Cooperative Research and Development Agreements - CRADAs).

In-House Report Web Site

This report can be found in the **DOCUMENTS** section on the DDR&E Laboratory Initiatives Web Site at *www.dtic.mil/labman,* for on-line browsing or downloading as a Word document or an Adobe Acrobat PDF document.

Distribution

This publication should be given widespread distribution in the DoD Laboratories, both as an internal resources reference document at the Director and Commanding Officer levels, and as a catalog of general activity at the bench level. It provides laboratory staff an opportunity to familiarize themselves with the functional capabilities of other DoD Laboratories, thereby encouraging scientists and engineers to communicate with their counterparts at other labs on problems of common interest.

Delores M. Etter

Delores M. Etter
Deputy Director, Defense Research and Engineering

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TABLES

NOTE: Lab Activities are represented as independent entities. The funding noted in the In-House Report represents the amount of funding each Lab Activity has available to perform its work, and includes direct funding and reimbursables. Transfers of funds between these Activities are reflected in the funding of both Activities, and therefore, it is not prudent to total the funding of all Activities for each Service.

TABLE 1. ARMY RDT&E ACTIVITIES, PROGRAM AND PERSONNEL DATA, FY2000

	FUNDING DATA (MILLIONS $)				PERSONNEL DATA					
INSTALLATION	TOTAL	TOTALS IN-HOUSE	TOTALS RDT&E	IN-HOUSE RDT&E	TOTAL MIL	TOTAL CIV	DOC MIL	DOC CIV	S&E MIL	S&E CIV
Aeromedical Research Laboratory	10.582	9.072	6.462	5.677	39	47	6	8	16	7
Armament RDEC	578.751	280.922	302.380	105.657	36	3049	0	58	25	1609
Army Evaluation Center	43.635	19.870	32.801	18.207	14	206	0	13	0	144
Army Materiel Systems Analysis Activity	45.150	32.845	15.195	13.242	3	297	0	7	0	184
Army Res. Inst. for the Behavioral and Social Sciences	29.072	11.389	26.497	9.605	3	120	0	47	2	31
Army Research Institute of Environmental Medicine	20.360	16.789	14.589	11.166	64	99	21	22	17	43
Army Research Laboratory	716.863	220.530	601.798	185.148	53	2062	4	360	27	885
Aviation and Missile RDEC	691.863	176.543	472.492	78.217	11	1996	0	60	0	1371
CECOM RDEC	512.247	106.815	367.419	69.839	28	1617	2	67	4	1023
Engineer Research and Development Center	435.389	190.155	347.415	172.122	17	1975	0	268	0	788
HQ Development Test Command	25.525	2.064	23.461	0.000	11	181	0	2	0	71
Aberdeen Test Center	123.182	77.120	65.748	40.936	5	742	0	5	1	211
Aviation Technical Test Center	12.047	12.047	10.292	10.292	21	85	0	2	0	29
Dugway Proving Ground	87.471	36.385	6.540	2.705	8	440	1	19	0	64
Redstone Technical Test Center	63.504	63.504	28.658	28.658	0	134	0	0	0	89
White Sands Missile Range	357.415	101.478	228.080	71.239	60	1739	0	11	0	497
Yuma Proving Ground	138.133	49.648	91.280	45.780	31	600	0	0	0	104
Institute of Surgical Research	17.049	17.049	8.222	8.222	146	58	16	8	33	24
Medical Research Institute of Chemical Defense	33.517	25.762	27.564	19.809	54	140	15	28	9	29
Medical Research Institute of Infectious Diseases	61.009	60.023	42.853	41.867	210	233	44	51	32	62
Operational Test Command	122.900	122.900	86.200	86.200	281	551	0	1	27	92
Soldier and Biological Chemical Command RDEC	296.322	130.795	148.364	58.241	35	1348	0	50	0	570
Tank Automotive RDEC	365.468	75.657	289.854	22.748	13	1035	0	26	7	626
Walter Reed Army Institute of Research	89.371	89.371	60.037	60.037	339	382	97	71	61	161

NOTE: Lab Activities are represented as independent entities. The funding noted in the In-House Report represents the amount of funding each Lab Activity has available to perform its work, and includes direct funding and reimbursables. Transfers of funds between these Activities are reflected in the funding of both Activities, and therefore, it is not prudent to total the funding of all Activities for each Service.

TABLE 2. ARMY RDT&E ACTIVITIES, FACILITY DATA, FY2000

		SPACE AND PROPERTY						
			SPACE (THOUSANDS OF SQ FT)				COST (MILLIONS $)	
INSTALLATION	HEADQUARTERS LOCATION	ACRES	LAB	ADMIN	OTHER	TOTAL	REAL PROPERTY	EQUIPMENT
Aeromedical Research Laboratory	Fort Rucker, AL	4	69.000	22.000	37.000	128.000	10.853	45.349
Armament RDEC	Picatinny Arsenal, NJ	6493	325.270	884.537	2669.609	3879.416	194.676	160.799
Army Evaluation Center	Alexandria, VA	0	0.000	83.100	0.000	83.100	0.000	0.000
Army Materiel Systems Analysis Activity	Aberdeen Proving Ground, MD	4	0.000	105.389	17.100	122.489	3.617	4.069
Army Rsrch Inst. for the Behavioral and Social Sciences	Alexandria, VA	0	12.325	53.600	3.425	69.350	12.978	11.248
Army Research Institute of Environmental Medicine	Natick, MA	1	44.581	19.483	43.732	107.796	9.508	27.942
Army Research Laboratory	Adelphi, MD	5345	1356.000	978.000	721.000	3055.000	697.141	610.675
Aviation and Missile RDEC	Redstone Arsenal, AL	4005	1093.216	358.926	251.113	1703.255	237.857	384.088
CECOM RDEC	Ft. Monmouth, NJ	1077	535.000	238.000	99.000	872.000	85.000	302.200
Engineer Research and Development Center	Vicksburg, MS	862	2661.230	441.120	345.770	3448.120	542.417	605.247
HQ Development Test Command	Aberdeen Proving Ground, MD	0	0.000	0.000	0.000	0.000	0.000	0.000
Aberdeen Test Center	Aberdeen Proving Ground, MD	56707	123.720	137.800	1006.630	1268.150	580.700	169.700
Aviation Technical Test Center	Fort Rucker, AL	11005	0.000	89.633	125.004	214.637	3.600	121.039
Dugway Proving Ground	Dugway, UT	798855	205.000	132.500	1866.000	2203.500	182.000	73.000
Redstone Technical Test Center	Redstone Arsenal, AL	14000	580.000	62.000	168.000	810.000	320.000	0.000
White Sands Missile Range	WSMR, NM	2281659	1734.967	977.702	2851.736	5564.405	509.956	765.443
Yuma Proving Ground	Yuma, AZ	1008904	22.030	116.655	2074.770	2213.455	179.448	183.128
Institute of Surgical Research	Fort Sam Houston, TX	1	73.850	11.000	50.300	135.150	17.191	18.114
Medical Research Institute of Chemical Defense	Aberdeen Proving Ground, MD	30	37.419	38.433	125.024	200.876	23.400	31.900
Medical Research Institute of Infectious Diseases	Fort Detrick, MD	169	334.110	8.125	20.317	362.552	24.900	43.500
Operational Test Command	Fort Hood, TX	22	0.000	459.000	214.000	673.000	33.100	0.000
Soldier and Biological Chemical Command RDEC	Aberdeen Proving Ground, MD	58	1222.000	375.000	485.000	2082.000	143.000	129.840
Tank Automotive RDEC	Warren, MI	101	530.949	174.870	22.202	728.021	142.474	278.133
Walter Reed Army Institute of Research	Silver Spring, MD	0	513.706	53.810	11.100	578.616	274.000	47.600

TABLE 3. NAVY RDT&E ACTIVITIES, PROGRAM AND PERSONNEL DATA, FY2000

INSTALLATION	FUNDING DATA (MILLIONS $)				PERSONNEL DATA					
	TOTAL	TOTALS IN-HOUSE	TOTALS RDT&E	IN-HOUSE RDT&E	TOTAL MIL	TOTAL CIV	DOC MIL	DOC CIV	S&E MIL	S&E CIV
Naval Air Warfare Center [1]	2922.652	1546.605	1087.469	607.146	1813	8962	2	197	212	3762
Naval Facilities Engineering Services Center	167.227	90.010	37.130	17.483	7	510	0	18	0	298
Naval Health Research Center	57.572	19.243	41.340	13.273	68	101	28	17	7	30
Naval Medical Research Center	50.739	41.257	38.912	33.105	183	359	70	52	15	77
Naval Research Laboratory	762.332	384.541	631.557	337.094	173	2720	5	802	0	792
Naval Surface Warfare Center [1]	2440.522	1281.150	983.217	527.926	257	9800	1	354	42	5179
Naval Undersea Warfare Center [1]	694.274	408.446	242.858	175.184	49	2659	0	120	0	1670
Navy Clothing and Textile Research Facility	4.789	3.906	1.929	1.534	0	28	0	1	0	17
Space and Naval Warfare Systems Center, San Diego [1]	1315.264	540.062	637.774	170.885	72	3446	1	186	0	1601

NOTES:

1. The four Naval warfare centers provide full spectrum research, development, test and evaluation, engineering, and fleet support services and perform a substantial amount of non-RDT&E work. Prior to FY1998, the Navy reported each warfare center in its entirety, even though a considerable amount of the reported end strengths, funding, and other resources were devoted to other than RDT&E programs. For purposes of more accurately reflecting RDT&E In-House resources in this report, the Navy has applied the established RDT&E In-House criteria (i.e., a minimum of 25% of total funds is RDT&E and a minimum of 25% of in-house effort is devoted to RDT&E) at the division or major site level rather than reporting all warfare center sites, regardless of their level of RDT&E work. As a result, some warfare center entities have been eliminated from this report because they are below the 25% RDT&E threshold for inclusion in this report.

2. Lab Activities are represented as independent entities. The funding noted in the In-House Report represents the amount of funding each Lab Activity has available to perform its work, and includes direct funding and reimbursables. Transfers of funds between these Activities are reflected in the funding of both Activities, and therefore, it is not prudent to total the funding of all Activities for each Service.

TABLE 4. NAVY RDT&E ACTIVITIES, FACILITY DATA, FY2000

		SPACE AND PROPERTY						
			SPACE (THOUSANDS OF SQUARE FEET)				COST (MILLIONS $)	
INSTALLATION	HEADQUARTERS LOCATION	ACRES	LAB	ADMIN	OTHER	TOTAL	REAL PROPERTY	EQUIPMENT
Naval Air Warfare Center *	Patuxent River, MD	1136307	6750.787	799.308	5759.201	13309.296	1416.323	515.606
Naval Facilities Engineering Services Center	Port Hueneme, CA	10	68.000	84.000	35.000	187.000	30.000	8.700
Naval Health Research Center	San Diego, CA	0	196.567	48.752	13.940	259.259	19.635	9.797
Naval Medical Research Center	Silver Spring, MD	7	229.500	71.688	79.552	380.740	21.770	15.120
Naval Research Laboratory	Washington, DC	533	3201.107	196.714	323.615	3721.436	194.466	485.497
Naval Surface Warfare Center *	Arlington, VA	9412	4864.190	1364.934	7292.887	13522.011	927.460	537.497
Naval Undersea Warfare Center *	Newport, RI	719	1639.000	287.000	506.000	2432.000	206.019	377.530
Navy Clothing and Textile Research Facility	Natick, MA	0	12.667	16.000	0.000	28.667	4.373	2.805
Space and Naval Warfare Systems Center, San Diego *	San Diego, CA	553	1339.000	992.000	1976.000	4307.000	116.210	234.141

***NOTE:** The four Naval warfare centers provide full spectrum research, development, test and evaluation, engineering, and fleet support services and perform a substantial amount of non-RDT&E work. Prior to FY1998, the Navy reported each warfare center in its entirety, even though a considerable amount of the reported end strengths, funding, and other resources were devoted to other than RDT&E programs. For purposes of more accurately reflecting RDT&E In-House resources in this report, the Navy has applied the established RDT&E In-House criteria (i.e., a minimum of 25% of total funds is RDT&E and a minimum of 25% of in-house effort is devoted to RDT&E) at the division or major site level rather than reporting all warfare center sites, regardless of their level of RDT&E work. As a result, some warfare center entities have been eliminated from this report because they are below the 25% RDT&E threshold for inclusion in this report.

TABLE 5. AIR FORCE RDT&E ACTIVITIES, PROGRAM AND PERSONNEL DATA, FY2000

INSTALLATION	FUNDING DATA (MILLIONS $)				PERSONNEL DATA					
	TOTAL	TOTALS IN-HOUSE	TOTALS RDT&E	IN-HOUSE RDT&E	TOTAL MIL	TOTAL CIV	DOC MIL	DOC CIV	S&E MIL	S&E CIV
46th Test Wing	588.592	265.251	478.991	243.211	4089	2804	2	16	82	660
Arnold Engineering Development Center	321.036	289.703	264.531	244.486	98	194	1	2	9	71
Flight Test Center	828.694	448.722	571.975	258.201	3385	2699	0	8	0	522
HQ Air Force Research Laboratory	36.324	0.000	36.324	0.000	71	164	4	5	40	52
Air Force Office of Scientific Research	345.705	0.000	216.305	0.000	27	103	12	37	5	6
Air Vehicles Directorate	107.149	60.713	84.869	38.433	41	280	4	49	31	151
Directed Energy Directorate	188.784	18.413	106.939	10.978	175	353	18	98	66	92
Human Effectiveness Directorate	148.341	31.036	115.748	27.015	195	322	19	77	72	100
Information Directorate	539.532	75.209	435.671	56.112	95	740	3	30	49	309
Materials Directorate	241.450	44.465	181.870	31.250	58	443	4	89	42	244
Munitions Directorate	112.322	19.754	69.968	16.360	63	251	5	36	41	140
Propulsion Directorate	275.257	35.033	275.237	35.013	72	427	0	84	0	205
Sensors Directorate	305.466	21.207	305.466	21.207	73	542	13	69	49	351
Space Vehicles Directorate	290.440	26.796	250.986	23.791	130	452	9	90	67	136

NOTES:

1. The Air Force personnel numbers reflect the total number of personnel assigned at Air Force organizations with 25% or more of their mission dedicated to RDT&E. These numbers include a significant number of personnel assigned to base operating support activities who are not performing RDT&E workload and who would not be at given locations if not for deployable combat missions. These numbers count personnel, not programmed end strength as reflected in the Future Years Defense Program (FYDP), and should not be used for any comparison or basis of judging the Air Force RDT&E end strength.

2. Lab Activities are represented as independent entities. The funding noted in the In-House Report represents the amount of funding each Lab Activity has available to perform its work, and includes direct funding and reimbursables. Transfers of funds between these Activities are reflected in the funding of both Activities, and therefore, it is not prudent to total the funding of all Activities for each Service.

TABLE 6. AIR FORCE RDT&E ACTIVITIES, FACILITY DATA, FY2000

		SPACE AND PROPERTY						
		SPACE (THOUSANDS OF SQUARE FEET)					COST (MILLIONS $)	
INSTALLATION	HEADQUARTERS LOCATION	ACRES	LAB	ADMIN	OTHER	TOTAL	REAL PROPERTY	EQUIPMENT
46th Test Wing	Eglin AFB, FL	463546	0.000	93.438	1612.145	1705.583	292.890	530.900
Arnold Engineering Development Center	Arnold AFB, TN	39081	225.049	504.151	2131.260	2860.460	1410.597	236.449
Flight Test Center	Edwards AFB, CA	297732	343.102	279.470	8788.327	9410.899	875.170	278.460
HQ Air Force Research Laboratory	Wright-Patterson AFB, OH	1	0.000	49.000	0.000	49.000	1.914	1.400
Air Force Office of Scientific Research	Arlington, VA	0	0.000	25.250	0.000	25.250	0.000	0.000
Air Vehicles Directorate	Wright-Patterson AFB, OH	36	358.519	132.612	110.460	601.591	306.476	855.671
Directed Energy Directorate	Kirtland AFB, NM	4325	382.000	85.000	132.000	599.000	92.308	32.000
Human Effectiveness Directorate	Wright-Patterson AFB, OH	118	287.062	214.009	126.069	627.140	498.190	62.743
Information Directorate	Rome, NY	84	1065.400	89.200	220.300	1374.900	54.500	83.500
Materials Directorate	Wright-Patterson AFB, OH	135	294.500	189.300	83.400	567.200	103.800	43.800
Munitions Directorate	Eglin AFB, FL	1159	202.825	19.103	43.253	265.181	22.644	35.864
Propulsion Directorate	Wright-Patterson AFB, OH	41642	1273.000	16.000	130.000	1419.000	1651.000	127.500
Sensors Directorate	Wright-Patterson AFB, OH	100	279.336	121.109	53.149	453.594	181.445	43.500
Space Vehicles Directorate	Kirtland AFB, NM	5787	237.000	67.000	450.000	754.000	153.000	364.000

TABLE 7. USUHS RDT&E ACTIVITIES, PROGRAM AND PERSONNEL DATA, FY2000

INSTALLATION	FUNDING DATA (MILLIONS $)				PERSONNEL DATA					
	TOTAL	TOTALS IN-HOUSE	TOTALS RDT&E	IN-HOUSE RDT&E	TOTAL MIL	TOTAL CIV	DOC MIL	DOC CIV	S&E MIL	S&E CIV
Armed Forces Radiobiology Research Institute	11.847	11.847	10.594	10.594	48	73	0	16	0	18

TABLE 8. USUHS RDT&E ACTIVITIES, FACILITY DATA, FY2000

INSTALLATION	HEADQUARTERS LOCATION	SPACE AND PROPERTY						
			SPACE (THOUSANDS OF SQUARE FEET)				COST (MILLIONS $)	
		ACRES	LAB	ADMIN	OTHER	TOTAL	REAL PROPERTY	EQUIPMENT
Armed Forces Radiobiology Research Institute.	Bethesda, MD	10	61.750	34.257	77.235	173.242	18.610	10.708

DEPARTMENT OF THE ARMY

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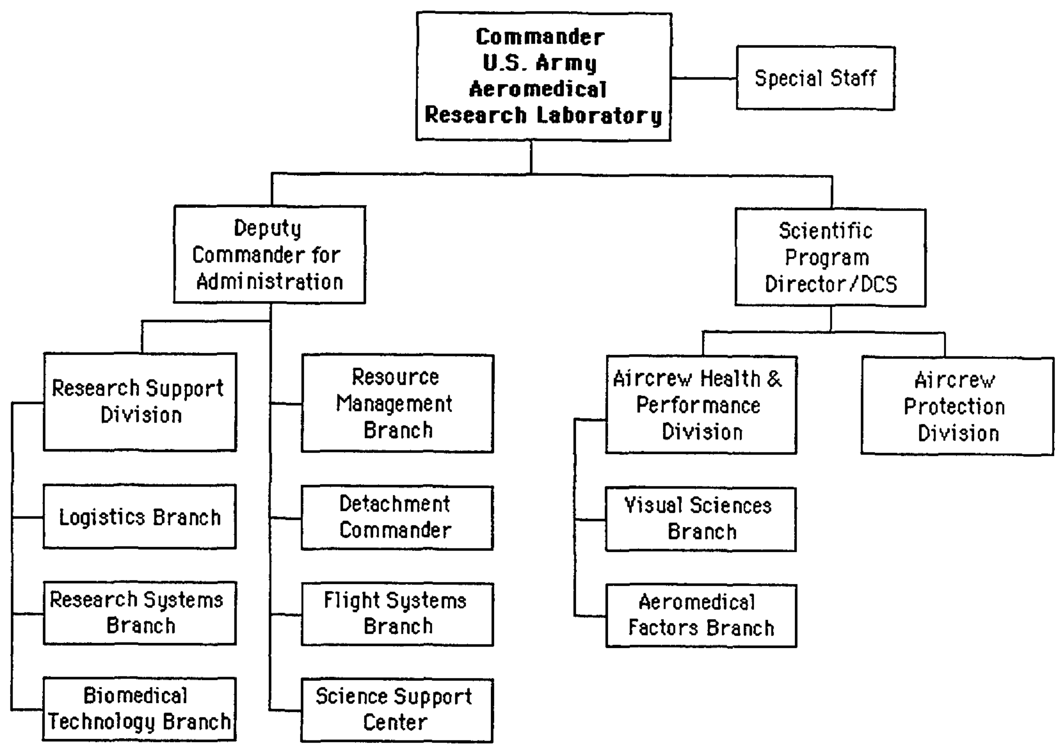
DEPARTMENT OF THE ARMY

The Army's twenty-four (24) In-House RDT&E Activities are:

Aeromedical Research Laboratory

FY2000 Abbreviated Functional Chart - Technical Organizations



Aeromedical Research Laboratory
Fort Rucker, AL 36362-0577
(334) 255-6917

Commander: COL John A. Powell
Sci Pro Dir/DCS: Dr. Kent A. Kimball

MISSION

Conducts research and development on health hazards of Army aviation, tactical combat vehicles, selected weapons systems, and airborne operations. Assesses the health hazards from noise, acceleration, impact, and visual demands of these systems and defines measures to offset hazards. Assesses stress and fatigue in personnel operating aviation systems and develops countermeasures. Assists in the development of criteria upon which to base standards for entry and retention in Army aviation specialties. Assists other U.S. Army Medical Research and Materiel Command laboratories and institutes in research on the bioeffects of laser systems, medical defense against chemical agents, impact of continuous operations on individual and crew performance, development of improved means of patient evacuation and in the test and evaluation of medical equipment used in aeromedical evacuation. Assesses current life support equipment to identify causes of failure, and devises improved design criteria. Assists the combat developers and materiel developers of new Army aviation and tactical combat vehicles systems to recognize and eliminate health hazards as early as possible in the developmental cycle. Conducts collaborative research with Department of Defense and other federal agencies on medical research and development issues of common concern.

CURRENT IMPORTANT PROGRAMS

Helmet Protective Capability/Tolerance to Head Supported Mass

Spatial Disorientation in the Rotary-Wing Environment and Countermeasures

Injury Prevention and Restraint Technologies for Ground and Air Vehicles

Optimization of Visual Performance with Optical and Electro-Optical Systems

Aviator Performance Effects of Sustained Operations, Sleep Cycle Disruption and Coping Mechanisms

Airworthiness Certification Evaluations of Medical Devices for Use Aboard Army Rotary-Wing Aircraft During Medical Evacuations

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRADAs)

BCI International for collaborative research, development, test, and evaluation on MEDEVAC Equipment

Bethel College for collaborative research, development, test, and evaluation on aeromedical equipment

Communications & Ear Protection, Inc. for collaborative RDT&E of hearing protective devices

CURRENT IMPORTANT PROGRAMS

Heartstream, Inc. for collaborative RDT&E on aeromedical equipment

H. Koch & Sons for collaborative research on advanced aircrew restraint systems

Honeywell for collaboration in visual testing of image intensifier components and systems

ITT Defense for collaborative research in visual testing of image intensifier components and systems

L3 Communications for collaboration on software support for simulation devices

PhysioControl Corporation for research, development, test, and evaluation of the LifePak 10

Purdue University for collaborative research in hierarchically ordered information in intelligent multifunction displays

Rush Support Medical for development of advanced helmet technologies

Simula Technologies, Inc. for research in advanced aircrew protection systems

SpaceLabs Medical Corporation for collaborative research, development, test, and evaluation on aeromedical equipment

Troy State University for loan of equipment for use in teaching undergraduate science classes

University of South Carolina Medical Department of Ophthalmology for research and development on visual performance issues in aviation

EQUIPMENT/FACILITIES

Multi-Axis Ride Simulation System

Helmet Drop Test Tower and Impact Facility

Variable Center of Gravity Helmet Device

Head and Neck Inertial Loading Sled

Mass Properties (Center of Mass Location & Mass Moments of Inertia) Measurement System

Biochemistry Lab

UH-60 Visual Flight Simulator for Aeromedical Research

Helicopter Inflight Monitoring System

Modified Aircraft for Inflight Medical Research (JUH-1 Huey; JUH-60 Blackhawk)

EQUIPMENT/FACILITIES

Data Acquisition and Telemetry Systems for use in either JUH-1 or JUH-60

Sleep Study Center

Spatial Disorientation Laboratory

Crew Coordination Analysis Center

High Intensity Impulse Noise Generator (Shock Tube)

Mobile Acoustics Lab Anechoic and Reverberation Chambers

Scanning Laser Ophthalmoscope

Ophthalmic Telemedicine System

Corneal Physiology and Topography Center

Optical Testing Lab

Optical Fabrication Facility

Electro-Optical Testing Lab

Visual Displays Analysis Center

Scientific and Medical Research Information Center

MEDEVAC Equipment Testing Facility

Aeromedical Research Laboratory
Fort Rucker, AL 36362-0577
(334) 255-6917

Commander: COL John A. Powell
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FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.048	N/A	N/A	0.048
6.1 Other	0.302	0.000	0.043	0.345
6.2	5.146	0.050	0.317	5.513
6.3	0.000	0.000	0.000	0.000
Subtotal (S&T)	**5.496**	**0.050**	**0.360**	**5.906**
6.4	0.060	0.000	0.000	0.060
6.5	0.056	0.000	0.000	0.056
6.6	0.021	0.000	0.375	0.396
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.044	0.000	0.000	0.044
TOTAL RDT&E	**5.677**	**0.050**	**0.735**	**6.462**
Procurement	0.095	N/A	0.000	0.095
Operations & Maintenance	0.001	N/A	0.000	0.001
Other	3.299	N/A	0.725	4.024
TOTAL FUNDING	**9.072**	**0.050**	**1.460**	**10.582**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	6	16	17	39
CIVILIAN	8	7	32	47
TOTAL	**14**	**23**	**49**	**86**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	69.000	**REAL PROPERTY**	10.853
ADMIN	22.000	* NEW CAPITAL EQUIPMENT	0.226
OTHER	37.000	**EQUIPMENT**	45.349
TOTAL	**128.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.488
ACRES	**4**	* Subset of previous category.	

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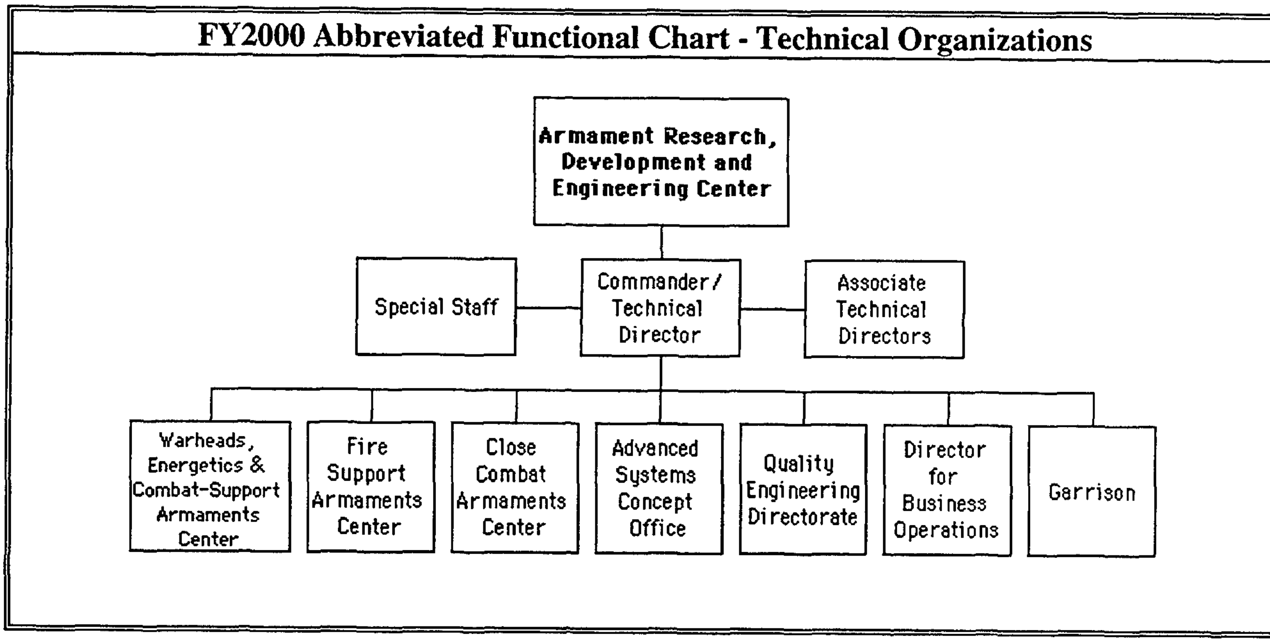
Armament RDEC



Armament RDEC
Picatinny Arsenal, NJ 07806-5000
(973) 724-6000

Commander: BG Wm M. Lenaers
Technical Director: Mr. Michael P. Devine

MISSION

TACOM-ARDEC is a business center of the Tank-Automotive and Armaments Command (TACOM), a major subordinate command of the US Army Materiel Command (AMC). TACOM-ARDEC provides the United States military with the firepower to achieve decisive battlefield victory. Our mission is to conduct or manage research, development and life cycle engineering, including quality engineering for ammunition, weapons, fire control and associated items. This includes engineering support for production and integrated logistics support. We provide procurement and management of initial production quantities and technical support to soldiers and equipment in the field throughout their entire life cycle. TACOM-ARDEC is also the Army executive agent for research and development for pollution prevention.

The primary function of TACOM-ARDEC is to be the smart buyer for armaments and the integrator of complex technologies into armament systems. TACOM-ARDEC currently retains the technical knowledge and expertise for current, historical and future experimental and developmental ammunition and weapon systems, many of which have no counterpart in industry. In order to develop and maintain this knowledge base, TACOM-ARDEC is active in all phases of the life cycle process. We maintain a technology base to assure that technologies transition to weapon systems developments, which currently account for over 90% of the Army's lethality. TACOM-ARDEC performs system analyses that consider a diverse number of systems and technologies, both in-house and contractor developed, resulting in the best technical approach and best buy decisions. TACOM-ARDEC also performs technical assessments of the current state-of-the-art in ammunition and weapon systems that points the way to future developmental programs and technology transfer to industry.

CURRENT IMPORTANT PROGRAMS

Our core business areas and corresponding technical initiatives are:

FUTURE COMBAT SYSTEM (FCS) MULTI-ROLE ARMAMENT AND AMMUNITION SUITE: To develop and demonstrate a lightweight, multi-mission armament system and ammunition suite as the main armament system for the FCS. This includes a multi-role cannon and associated munitions for extended range direct and indirect engagements.

SMART MUNITIONS: To develop self-contained munitions for all mission areas with the ability to autonomously sense, engage, and kill their intended targets.

INDIRECT FIRE: To maximize defeat of enemy personnel and vehicular targets by developing advanced artillery and mortars with extended range and accuracy. We will achieve autonomous operations, increase range, increase rate of fire, and reduce manpower requirements over current fielded systems.

CURRENT IMPORTANT PROGRAMS

DIRECT FIRE: To develop weapons and munitions which will defeat the most advanced enemy armor through increased frontal penetration, higher hit probabilities, and enhanced top attack capabilities, while reducing crew size and stress.

SOLDIER WEAPONS: To upgrade armaments for light infantry and special operation forces (SOF), and to develop advanced, small caliber weapons that will significantly increase kill capability, enhance survivability and improve the capability to destroy hard targets, and to develop non-lethal weapons for low intensity/peacekeeping missions.

MINES & DEMOLITIONS: To defeat or deter advanced helicopters, vehicles & personnel with highly intelligent minefields, with features such as area denial, complete user control, and Identification Friend or Foe (IFF) capability, as well as alternatives to personnel landmines.

FUZING & LETHAL MECHANISMS: To greatly increase the lethality of armament materiel by focusing on advanced chemical energy warheads (shaped charge and explosively formed penetrators), kinetic energy (KE) penetrators, associated warhead materials, and low collateral damage munitions. Also, to create fuzes with integrated sensors, signal processing, and guidance and control; capable of performing target/clutter discrimination and having multi-option capability for compatibility with autoloaders, and containing electronic safe and arm (S&A) functions.

FIRE CONTROL: To provide life cycle engineering and management of fire control subsystems, software, command, control, and communications; test measurement and diagnostic equipment and training devices utilizing an integration of sensors, computers, advanced controls and artificial intelligence aids for a rapid response to command orders of engagement.

MUNITIONS SURVIVABILITY: Insure the survivability of the critical warfighting assets through Munitions Logistics, Munitions Survivability. The program provides "built in" survivability improvements that will help preclude destructive reactions within logistics nodes, transportation assets, and combat vehicles using proven/available technologies.

POLLUTION PREVENTION R&D: TACOM-ARDEC is the Army agent for pollution prevention R&D, providing the Army with technical management for pollution prevention R&D, integration of pollution prevention concerns into the weapons system R&D process, and technical assistance and integration expertise to the Army, other government agencies, and industry.

Some of our key strategic system initiatives are:

Precision Guided Mortar Munition (PGMM): PGMM is a 120mm Global Positioning System (GPS) / laser guided mortar munition with an extened range guide capability. PGMM is envisioned as the maneuver task force commander's "hip pocket" precision indirect fire weapon capable of providing responsive standoff defeat of threats behind protective cover. The target set includes crew served weapons, command posts, observers, etc. employed in fortified positions such as bunkers and buildings.

Light Weight 155mm Howitzer: The Light Weight 155mm Howitzer will be a lighter (40-50%) towed howitzer with digital fire control and advanced navigation systems. It will replace our current light division general support artillery system - the M198. The system provides improvements in lethality, survivability and responsiveness.

CURRENT IMPORTANT PROGRAMS

Battlefield Acoustic Sensors: Acoustic sensor technology will be enhanced to provide passive, non-line-of-sight target detection, classification and tracking of military targets including artillery, ground combat vehicles and aircraft.

Objective Individual Combat Weapon (OICW): OICW will be a lightweight weapon capable of firing kinetic energy projectiles and an air-bursting fragmentation munition. It will allow soldiers to effectively attack targets at greater ranges, and to attack targets in defilade. It combines leading edge technologies in miniaturized fuzing; integrated fire control; lightweight, high strength materials; and munitions effects. OICW will increase the lethality and survivability of the individual soldier. It is the sole lethality component of the Dismounted Battle Lab's 21st Century Land Warrior (21 CLW) Top Level Demonstration.

Objective Crew Served Weapon (OCSW): The OCSW will be a lightweight, 2-man portable, crew-served weapon system providing the dismounted soldier with overwhelming lethality resulting in increased survivability through long range defeat of defilade protected personnel targets. It will be a more effective replacement for selected medium and heavy machine guns.

Non-lethal Defeat Mechanisms: TACOM-ARDEC has taken a leading role in the development of Nonlethal Technologies. With increasing emphasis on peacekeeping, low-intensity conflict and humanitarian missions, it becomes important to devise weapons that restrain or immobilize. To this end, TACOM-ARDEC is developing weapons such as: sponge grenades (co-developed with ARL), which are designed to incapacitate without imparting serious injury; acoustic weapons, which project sound waves, causing nausea and disorientation; sting nets, which envelop a foe and deliver a nonlethal electrical shock to discourage struggle; laser and other directed energy munitions, which are designed to degrade vehicle sensors; and radio frequency and electromagnetic pulse weapons, which could be utilized against enemy equipment in order to disrupt their electronics. Many of these technologies serve as dual-use applications for use in riot-control and civil disturbance situations.

TACOM-ARDEC has over 52 active CRADAs. Some of these are:

1. Forcible Entry Device - Chancepts, LLC
2. Picatinny Innovation Center (PIC) - County College Morris
3. Semiconductor Epitaxial Films - Epitaxial Laboratory
4. Ultra-High Pressure Sterilization - Flow International Corporation
5. High Performance Computing in DIS - HPTi
6. Proximity Fuze Sensor Technology - KDI Precision Products, Inc.
7. Improving Accuracy of Stabilized Platforms - Kollmorgen Corporation
8. Developing Test Program Sets for Multiple Test Equipment Platforms - Boeing/McDonnell Douglas
9. Fuel Cells - Materials Tests/Modeling - Plug Power
10. Advanced Propulsion Technology - Primex
11. Characterization and Experimentation Evaluation of CL-20 Explosive - Stevens Institute of Technology
12. Ammunition Improvement and Development - Talley Defense Systems, Inc.
13. Air Acoustic Signal Processing - Textron Systems
14. Multi-Role ETC Armament System Virtual Prototype - UDLP
15. Shaped Charge Design for Oil Exploration - Baker/Hughes (formerly Western Atlas International)

EQUIPMENT/FACILITIES

The **Armament Technology Facility** (ATF) is a 52,000 square foot, secure and environmentally safe integrated small and cannon-caliber design and test facility. The ATF co-locates simulation modeling, design, validation, and diagnostic engineering with the capability to immediately conduct confirmation experimental firings of interior and exterior ballistics. This concurrent engineering facility will support multi-service infantry, air defense, aircraft, and combat vehicle armament systems and is available to thegovernment as well as private industry. It has four weapon validation bays with an environmental chamber capable of weather conditions between -65F to +165F; two indoor ranges - the first 100 meters in length and the second 300 meters. The latter can accept a Bradley Fighting Vehicle System firing its primary armament; or an Abrams-series tank firing secondary armament. The 300-meter range also has a -65F to +165F environmental chamber.

ARDEC's **Life Cycle Software Engineering (LCSE) Center** is a state-of-the-art facility consisting of the latest computer hardware, software, and environments used for designing, developing, testing, managing, controlling, storing, fielding, and maintaining Mission Critical Computer Resources (MCCR). Included in this MCCR are embedded software for Army Battlefield Automated Systems, Automated Trainers for Gunnery and Maintenance, Institutional and Field simulators and trainers, in support of Army TRADOC Schools. The Center supports such systems as the Paladin M109A6 Howitzer; Crusader; Abrams Family of Vehicles (M1, M1A1, and M1A2); and Bradley Fighting Vehicles System (BFVS). The TACOM LCSE Center is one of the three (3) charted Army Materiel Command LCSE Centers in support of all Army MCCR software.

Propellant Surveillance Facility: This unique facility is equipped with chambers heated to elevated temperatures in which large quantities of propellants undergo aging tests to determine safe lifetimes. This multi-service facility identifies propellant lots close to their maximum lifetime for destruction before a catastrophic accident occurs. Samples of propellants from field storage are also tested to ensure different environmental conditions don't degrade the propellant at a faster rate.

TACOM-ARDEC's **Distributed Interactive Simulation (DIS) Facility** supports a full spectrum of battlefield simulation activities to determine how technology, weapons, and weapon mixes can be used to maximize the effectiveness of the soldier. DIS analyses of weapons in combined arms scenarios can influence designs long before any metal has been "bent," thereby minimizing cost and development time. Linkage to other sites and real systems allow real-time interaction on a hybrid battlefield.

Small Arms Simulator: The Small Arms Simulator is a single lane computerized firing system with standard gun, M4 Carbine, converted for simulator use. Other weapons included in the simulator are the M203 Grenade Launcher and the M16A1/A2. All the guns retain their normal feel, operating characteristics, and features. Recoil and noise are realistically simulated and shooting accuracy matches that of the original weapons. The Ft. Pickett range and MOUT village has been digitized and implemented into the facility. All targets are graphically generated E-silhouettes and DI Guy soldiers with the capability to design the target scenario by the user. Graphical targets include pop-up, moving, stationary, or multiple targets at various ranges as defined by the user. It is presently being used to support programs through JSSAP and PMSA such as Objective Individual Combat Weapon (OICW) and M4 Carbine Alternate Butt Stock. The system is also being used to support Land Warrior, Force XXI Land Warrior, and Combat ID programs, which are managed by Soldier System Command (SSCOM) and CECOM.

EQUIPMENT/FACILITIES

Benet Labs represents the Army's capability for large caliber cannon research, design and development, prototype production and engineering support. Benet works closely with the Watervliet Arsenal's cannon production facility to provide rapid prototyping services in support of new and improved weapon systems. Some of Benet's facilities are:

FATIGUE EXPERIMENTATION FACILITY: Capability of duplicating firing pressures in its breech mechanism facility and tube facility. This allows the rapid evaluation of new concepts of materials, and the establishment of safe firing parameters for these components in the laboratory rather than the much more expensive experimental firing previously necessary. These combined facilities provide Benet with a capability not available elsewhere.

GAS DYNAMICS LABORATORY: The Gas Dynamics Laboratory is a new research multi-task facility, which includes two firing bays, a high bay area, and a laboratory. The high bay area is used for experiments for heavy weapons and weapon components. Instrumentation includes 12 channels of digital data capture and display in 3 synchronized nicolet oscilloscopes with 4K points per channel. There is also a data acquisition system with 10 channels at 256K points per channel.

TURRET LABORATORY: Benet Labs provides engineering support for Turret hardware (less fire control systems) for Tracked Combat Vehicles, including the M551 Light Weight Air Transportable Assault Vehicle, and M60A3 and M1A1 Main Battle Tanks. The Turret Laboratory currently houses all of these vehicles and the tools and equipment necessary for investigation of problems relating to field, depot, and spare parts procurement activities.

TERRAIN SUSPENSION/TURRET ENVIRONMENT SIMULATOR: This motion system consists of a large platform (18 ft x 10 ft) mounted on six large hydraulic cylinders, a hydraulic power supply unit and an electronic control cabinet. The simulator is a six-degree-of freedom system capable of providing all six motions simultaneously. The maximum payload that can be carried by the simulator is 18,000 lbs. Thus, it is capable of evaluating a full size tank turret.

FULL SCALE INVESTMENT CASTING FOUNDRY: Benet's investment casting foundry provides the necessary base from which technical support is provided to the Laboratory in the form of the development of new castings and providing prototype castings, to Watervliet Arsenal in the form of production castings to meet initial deliveries until a contractor can start full deliveries, and to Outside Contractors in the form of technical assistance to overcome problems encountered in meeting the requirements of castings for production.

VESSEL ELECTROPLATING FACILITY: A full-scale pilot production facility, built and operated by Benet Laboratories in a joint venture with the Watervliet Arsenal, provides a new process technology and the capability for plating an improved form of chromium (LC chrome) on any size cannon tube up to and including the 30-foot long 155-mm "Extended Range Cannon."

The **Keith L. Ware Simulation Center** is a research facility specializing in the analysis of helicopter armaments and small arms. The Ware Center is composed of two 100 meter indoor firing ranges and two 1000 inch indoor firing ranges. Small arms can be fired from any number of ground and vehicle mounts as well as several weapon mount simulators located at the center. Helicopter armaments are fired from the 6-Degree-of-Freedom simulator which is capable of mounting a helicopter fuselage and

EQUIPMENT/FACILITIES

inputting vibration and other motions into it. This allows armaments to be investigated in realistic conditions at a great cost savings over field trials. A large environmental room is available connected to one of the 1000 inch firing ranges. This room can subject items to extreme temperatures from -65 degrees F to +160 degrees F as well as other environmental conditions such as humidity, salt fog, salt immersion, sand and dust. The Ware Simulation Center has extensive instrumentation capabilities to measure characteristic data and performance of weapon systems such as: accuracy, dispersion, rate of fire, round velocity, blast pressure, recoil force, temperature, strain, acceleration, linear and angular displacement, voltage and current. High speed video and regular speed video are also available.

TACOM-ARDEC's **Stereolithography Lab** provides rapid prototyping for form, fit and function trials and produces masters for soft modeling and investment castings. The lab's capabilities range from the design and fabrication of a sheet "brass catcher" for the Squad Automatic Weapon to the modeling of complete scaled versions of the Crusader and Paladin recoil system prototypes. This service, available to TACOM-ARDEC engineers, academia and industry, reduces the developmental time and associated manufacturing and procurement costs by up to 75%.

The **Automated Inspection Device for Explosive Charge in Shell (AIDECS)** replaces visual x-ray film inspection of loaded artillery projectiles. The AIDECS pilot system at TACOM-ARDEC is the only operational unit of its kind, providing the capability to automatically examine 155mm rounds and smaller shells. Base separations, cracks, cavities and other critical defects in the explosive filler are detected by scanning the shell with x-rays. Radiation scattered from within the shell is electrically detected, and a computer analysis identifies and classifies each defect in the explosive. The computer makes an accept/reject decision for each shell and prints an inspection report. Benefits of the AIDECS system include improved reliability for detecting base separations and other critical defects accomplished in a totally automated manner, and cost savings due to elimination of x-ray film.

The Department of Defense's **Center for X-Ray Diffraction** at TACOM-ARDEC is well recognized for its complete line of sophisticated X-Ray equipment, including two of the latest diffractometers and spectrometers, as well as for the comprehensive knowledge and experience of its personnel. The facility is used to enhance ballistic performance by determining the optimal crystal orientation of warhead and penetrator materials.

The **Instrumentation and Measurements Lab** includes cutting-edge capabilities in the art of data reduction, signal processing, shock resistant telemetry design and radar analysis. One of its facilities consists of a radio frequency anechoic chamber equipped with a radar cross-section (RCS) measurement system utilizing a supercomputer. RCS measurements of various systems, including projectiles, identify radar reflectivity patterns. This technology is used for artillery experiments to evaluate and improve projectile performance parameters such as range, yawing motion, spin and position. Some services and capabilities include: Development of telemetry concepts and systems; Telemetry component technology; In-bore and in-flight telemetry techniques; Secure telemetry systems; Qualification, compatibility and RFI Coordination of telemetry operations with test ranges; Collection and reduction of telemetered firing test data; Printed Circuit Board design, fabrication and assembly; Measurement System Design and Implementation Acoustic and Magnetic Signature Analysis Image Analysis/ Processing; Industrial Control, Design and Implementation RF Anechoic Studies.

The **Advanced Warhead Facility** provides a 40 foot diameter reinforced concrete dome, lined with armor plate, that will be attached to a 35 foot long tunnel. This allows for extended target standoff

EQUIPMENT/FACILITIES

experiments for explosively formed penetrators, shaped charges and other experimental warheads. Traditional and heavy metal liners such as tantalum and tungsten will be accommodated. Instrumentation includes flash radiography, streak cameras and electronic streak array.

Our **subsonic, transonic and supersonic wind tunnels** provide excellent opportunities to apply research to time and cost savings. The facility is used to design, develop and conduct experiments on tactical and training rounds for the Army. The facility has been awarded twelve U.S. patents in the last five years. One of the patents was for a stabilizer for the M831A1 TP-T tank training ammunition, developed using wind tunnel data. Optimization resulting from the experiments saved an estimated $40 million in annual production costs.

Electromagnetic Environmental Effects (E3) facilities perform assessments on weapon systems to determine their compliance against numerous electromagnetic environments such as Personnel Electrostatic Discharge (PESD), Helicopter Electrostatic Discharge (HESD), Hazards of Electromagnetic Radiation to Ordnance (HERO), Electromagnetic Vulnerability (EMV), and Electromagnetic Interference (EMI). High explosives are also assessed at our facilities.

Armament RDEC
Picatinny Arsenal, NJ 07806-5000
(973) 724-6000

Commander: BG Wm M. Lenaers
Technical Director: Mr. Michael P. Devine

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	1.708	N/A	N/A	1.708
6.1 Other	0.504	0.256	2.582	3.342
6.2	21.824	6.664	67.310	95.798
6.3	2.889	5.246	58.050	66.185
Subtotal (S&T)	**26.925**	**12.166**	**127.942**	**167.033**
6.4	38.637	1.355	13.685	53.677
6.5	21.611	0.383	3.870	25.864
6.6	10.421	1.366	13.794	25.581
6.7	5.710	1.955	19.742	27.407
Non-DOD	2.353	0.042	0.423	2.818
TOTAL RDT&E	**105.657**	**17.267**	**179.456**	**302.380**
Procurement	74.240	N/A	54.744	128.984
Operations & Maintenance	96.180	N/A	43.214	139.394
Other	4.845	N/A	3.148	7.993
TOTAL FUNDING	**280.922**	**17.267**	**280.562**	**578.751**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	15.500

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	25	11	36
CIVILIAN	58	1609	1382	3049
TOTAL	**58**	**1634**	**1393**	**3085**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	325.270	**REAL PROPERTY**	194.676
ADMIN	884.537	* NEW CAPITAL EQUIPMENT	0.000
OTHER	2669.609	**EQUIPMENT**	160.799
TOTAL	**3879.416**	* NEW SCIENTIFIC & ENG. EQUIP.	1.427
ACRES	**6493**	* Subset of previous category.	

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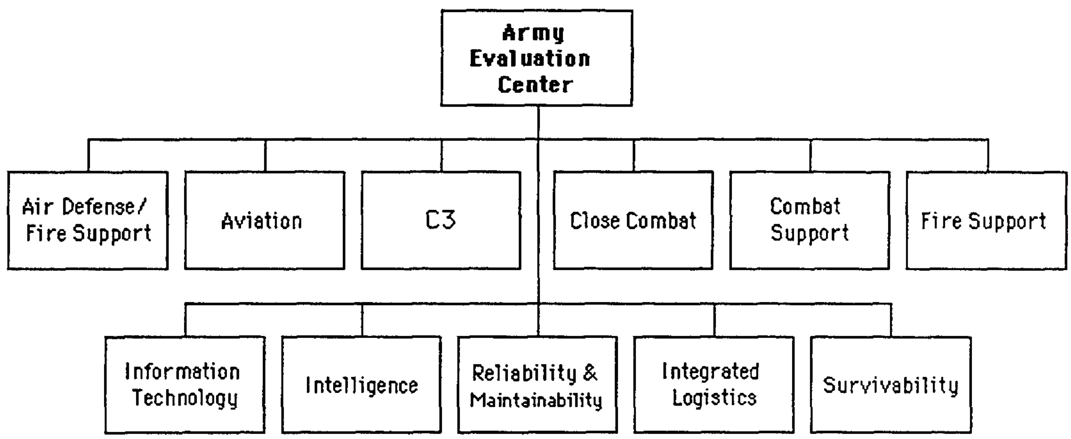
Army Evaluation Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Army Evaluation Center
Alexandria, VA 22303-1458
(703) 681-9872

Director: Dr. James J. Streilein
Associate Director: Mr. William J. Hughes

MISSION

The Army Evaluation Center (AEC) is the the Army's Independent Evaluator. The AEC provides integrated technical and operational evaluations and continuous evaluations of Major Defense Acquisition Programs, Major Automated Information System Review Council, and IPR programs for major milestone decisions, materiel changes and materiel releases in support of the Acquistion development and experimental processes. The AEC develops the evaluation strategy, designs technical and operational test and evaluates test results to address effectiveness, suitability and survivability.

CURRENT IMPORTANT PROGRAMS

The following sampling of programs that were worked on from FY00 are the following:

- ASAS
- FAAD C3I
- UAV
- BFVS-A3
- GBS
- STINGER
- Comanche
- ICH
- SIIRCM
- Transportation Systems
- Crusader
- GCCS-A
- IEWCS
- BAT
- JTAGS
- Software
- Blackhawk
- AVCATT
- BCIS
- Air Warrior
- CABS
- ATC
- SCAMP

EQUIPMENT/FACILITIES

Point-to-Point Video Tele-Conferencing (VTC) with direct link capability, desktop VTCs, CISCO Router direct linked, color copiers, Prioris dual processor server and cabletron hubs.

Army Evaluation Center
Alexandria, VA 22303-1458
(703) 681-9872

Director: Dr. James J. Streilein
Associate Director: Mr. William J. Hughes

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.000	0.000	0.000	0.000
6.3	0.000	0.000	0.000	0.000
Subtotal (S&T)	**0.000**	**0.000**	**0.000**	**0.000**
6.4	0.000	0.000	0.000	0.000
6.5	0.068	0.000	1.419	1.487
6.6	18.139	0.000	13.175	31.314
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**18.207**	**0.000**	**14.594**	**32.801**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	1.487	N/A	1.926	3.413
Other	0.176	N/A	7.245	7.421
TOTAL FUNDING	**19.870**	**0.000**	**23.765**	**43.635**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	14	14
CIVILIAN	13	144	49	206
TOTAL	**13**	**144**	**63**	**220**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	0.000	**REAL PROPERTY**	0.000
ADMIN	83.100	* NEW CAPITAL EQUIPMENT	0.000
OTHER	0.000	**EQUIPMENT**	0.000
TOTAL	**83.100**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**0**	* Subset of previous category.	

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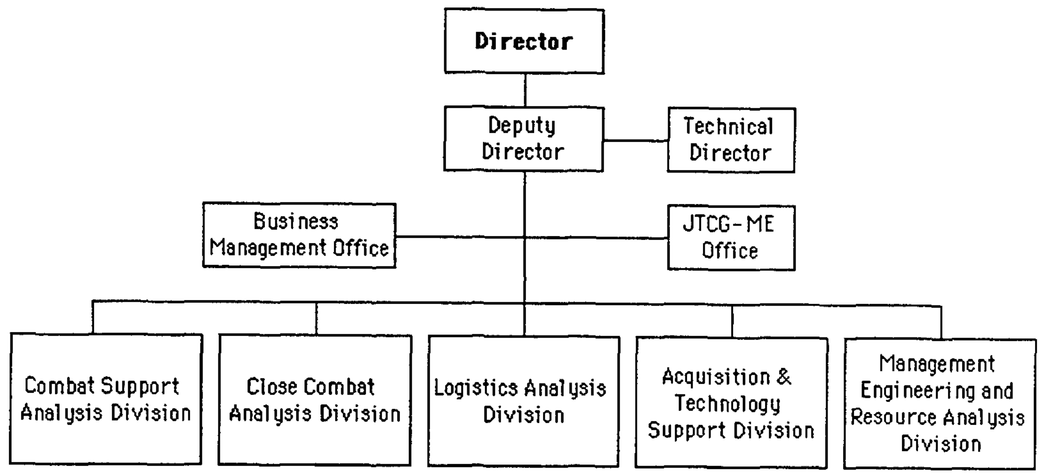
Army Materiel Systems Analysis Activity

FY2000 Abbreviated Functional Chart - Technical Organizations



Army Materiel Systems Analysis Activity
Aberdeen Proving Ground, MD 21005-5071
(410) 278-6614
Director: Mr. David J. Shaffer
Military Deputy: COL Pete Bucha

MISSION

Provide analysis of Army materiel and logistics systems to support decision-making for equipping and sustaining the Army.

CURRENT IMPORTANT PROGRAMS

The U.S. Army Materiel Systems Analysis Activity (AMSAA) has focused its analytical capabilities into five core business areas: item/system level performance and investment strategies; modeling and simulation (M&S); acquisition and technology support; logistics analysis; and business and resource analysis. These interdependent core competencies combine to provide the Army with analytical capabilities that are unique in both breadth and depth across the life cycle of Army materiel. Below are several paragraphs that summarize the capabilities and responsibilities in the Research, Development, Test, and Evaluation (RDT&E) and Operations and Maintenance Army (OMA) areas.

Primarily funded by RDT&E: AMSAA analyzes the performance and combat effectiveness of conceptual, developmental, and existing systems across the full spectrum of materiel commodity areas (e.g., armor, infantry, air defense, artillery, C4I, etc.). AMSAA conducts and supports systems analyses, such as: analyses of alternatives (AoA), system cost/performance trade-offs, early technology trade-offs, weapons mix analyses, and requirements analyses. AMSAA is the Army's center for item and system level performance analysis and certified data. AMSAA utilizes methodologies and models to characterize the functionality of Army materiel systems. Unique models and methodologies have been developed to accurately predict critical performance variables, such as, weapon accuracy, target acquisition, rate of fire, the probability of inflicting catastrophic damage, and system reliability. AMSAA is responsible for the generation of these effectiveness measures and for ensuring their standard use across Army and Joint studies. Item and system performance analyses are initiated in the technology base and evolve with the system through the entire acquisition cycle. AMSAA is actively involved in the planning and conduct of analyses in support of Army transformation initiatives, such as the Interim Armored Vehicle (IAV) family selection and the Future Combat Systems (FCS) program. AMSAA is also involved in the Army Science and Technology Objective and Advanced Technology Demonstration processes by examining how emerging technologies can potentially satisfy future Army requirements. AMSAA performs verification, validation, and certification of performance data, provides an analytical basis for the formulation of exit criteria, conducts performance analyses, and verifies, validates, and accredits (VV&A) required models and simulations. These capabilities support the timely transition of warfighting technologies from the tech base to materiel and system specific applications. AMSAA's linkage with the Integrated Concept Team (ICT) process creates an opportunity for the Army to take advantage of systems analysis even earlier. AMSAA is positioned to support ICTs through early requirements trade-off analyses before specific solutions are identified. The integration of cost as an independent variable, as part of this process will help ensure the development of cost-effective systems that will provide critical war-fighting capabilities to the future Army. As the Executive Agent for the Department of Defense (DoD) for the tri-service Joint Technical Coordinating Group/Munitions Effectiveness program, AMSAA applies its item and system level performance expertise to manage the

CURRENT IMPORTANT PROGRAMS

program and to ensure standardized weapons effectiveness assessments are used across the services. The publication of Joint Munitions Effectiveness Manuals provides single-source documents for modelers, materiel developers, and strategic and operational planners. AMSAA's M&S capabilities support the development, linkage, and accreditation of live, virtual, and constructive simulations, and provide unique tools that support systems analysis of both individual systems and combined arms environments. This M&S expertise is utilized both to strengthen the organization's internal capabilities and to provide critical capabilities to external customers. Internally, AMSAA has resident and maintains a significant number of models and simulations, most of which were developed in-house to address specific analytical voids. This M&S infrastructure provides a hierarchical modeling process that is unique to AMSAA and allows for a comprehensive performance prediction capability that can be utilized to make trade-off and investment decisions prior to extensive and expensive hardware testing. Externally, AMSAA applies its M&S capabilities to a wide variety of Army programs and activities. In Army Regulation (AR) 70-1, AMSAA is identified as the Army's Executive Agent for VV&A of item level performance models. In this role, AMSAA assists model developers with the development and execution of V&V plans to ensure new models and simulations faithfully represent actual systems. Additionally, AMSAA is extensively involved in M&S accreditation across the Army. Above the item level, AMSAA has gained extensive experience in the planning, execution and analysis of distributed interactive simulation exercises, and in the V&V of computer generated forces and system simulators. Shrinking modernization budgets have forced the Army to increasingly focus its research and development efforts toward fewer critical systems and capabilities that will equip the force with the most "bang for the buck." Investment decisions across weapon systems and technologies are being forced earlier in the process, with cost effectiveness playing an increasingly dominant role in these decisions. AMSAA has developed and implemented new methodologies capable of examining decision alternatives in terms of value-added, cost benefit, and total risk. Potential exists to conduct analyses within battlefield capabilities, such as, anti-armor, sensors, and command and control as well as to examine relative contributions across capabilities.

Primarily funded by OMA: AMSAA's logistics analysis expertise covers the full range of Army logistics needs, from the development and refinement of new logistics models to the analysis of innovative or modified logistics concepts. AMSAA is providing substantial analytical support to the Army's Logistics Modernization Program (LOGMOD), National Maintenance Management initiative, and legacy force recapitalization efforts as the Army works to reengineer logistics processes/systems to provide more responsive support to the soldier in the field. AMSAA's studies have led to recommendations for major changes to the Army logistics system resulting in significant improvements in the supply, maintenance, and transportation processes, such as, increased flexibility, responsiveness to the customer, reduction in the generation of excess, and providing the best mix of supplies in a timely manner. AMSAA supports the logistics part of the acquisition process with level of repair and initial provisioning analyses for materiel development programs. AMSAA works with the program manager to ensure initial provisioning stocks and maintenance concepts provide adequate logistics support and best value to the Army once systems are fielded. AMSAA is heavily engaged in analysis to support the Army planning process for sustaining our forces during operations other than war, contingency operations, and in war. AMSAA develops Supply Class IX spare part contingency support packages for the Area Support Group, Core Support Group, Direct Support, and/or Organizational levels during wartime contingency planning. These support packages have been instrumental in planning logistics support and have served to assist in Bosnia, Somalia, Rwanda, and numerous other Army Operations. AMSAA is actively involved in determining the sustainment footprint associated with new unit structures, such as the Interim Brigade Combat Team (IBCT), so that the logistics requirements associated with the Army's transformed force can be compared to requirements associated with forces using legacy systems.

CURRENT IMPORTANT PROGRAMS

AMSAA is the Army's Executive Agent for Sample Data Collection (SDC) and as part of this executes the Field Exercise Data Collection (FEDC) program providing quantitative and qualitative operational maintenance, manpower, reliability, and logistical support data for fielded materiel systems. Critical information is provided to warfighting units and this same information is used in analyses being conducted for senior Army leadership. AMSAA has been instrumental in the development, application, refinement, and investigation of models to support both wholesale and retail Army logistics operations and analysis. A library of models is maintained and new ones are regularly developed, as needed, either to support concept analysis or to improve a current methodology. AMSAA serves as the Army executive agent for reliability and maintainability standardization improvement by developing and implementing reliability and maintainability acquisition reform initiatives. AMSAA develops and applies reliability engineering approaches that assess the reliability of Army materiel and recommend ways to reduce life cycle costs and create more robust designs. The Physics of Failure (PoF) program pioneered development of design and analysis tools to predict reliability and minimize potential redesign at the component level. PoF is based on the fundamental principle that it is not only important to understand how things work, but equally important to understand how things can fail under the intended operational environments. AMSAA supports a broad range of efforts to improve the acquisition process and to apply new technology to the development and production of Army materiel. For example, continuous evaluations of military specifications and standards to include support in converting to commercial item descriptions and the preparation of performance specifications are conducted. To ensure new materiel can be produced and existing materiel can have significant modifications, production engineering and readiness reviews are conducted. AMSAA exercises overall program direction for the execution of the AMC Management Engineering Program. This includes the Workload Based Staffing Analysis Program and the Army Workload and Performance System. With all of the reductions occurring throughout AMC, AMSAA will be responsible for conducting and overseeing many outsourcing/privatization analyses and commercial activity studies. AMSAA ensures that the Army's approved 12-step process is appropriately applied AMC-wide. In this capacity, AMSAA validates AMC's personnel levels against actual workload requirements and defends these positions during the Army's POM and TAA processes.

AMSAA's overall RDT&E and OMA program provides the Army with the critical information and analysis needed to facilitate the complex decisions required to transfer the Army into a more "deployable, agile, versatile, lethal, survivable and sustainable" force that is affordable, responsive and dominant. In an environment of constrained resources, it is critical the Army leadership continue to have access to timely, reliable, and high quality analysis on which they can base the decisions required to shape the future Army. AMSAA has developed and continued to improve an integrated set of skills and tools focused on its core competencies to be responsive to the breadth and depth of systems analysis requirements for the Army as it works to tailor itself to meet the challenge of the 21st century.

EQUIPMENT/FACILITIES

AMSAA has a unique Simulation Facility used for processing highly classified material and also the development, verification, validation, and accreditation of models and simulations. AMSAA also has additional facilities and equipment for use in the conduct of systems analysis.

Army Materiel Systems Analysis Activity
Aberdeen Proving Ground, MD 21005-5071
(410) 278-6614

Director: Mr. David J. Shaffer
Military Deputy: COL Pete Bucha

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.200	0.000	0.000	0.200
6.3	1.238	0.000	0.040	1.278
Subtotal (S&T)	**1.438**	**0.000**	**0.040**	**1.478**
6.4	1.006	0.000	0.000	1.006
6.5	0.535	0.000	0.000	0.535
6.6	9.630	0.000	1.746	11.376
6.7	0.633	0.000	0.167	0.800
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**13.242**	**0.000**	**1.953**	**15.195**
Procurement	0.100	N/A	0.000	0.100
Operations & Maintenance	15.106	N/A	2.376	17.482
Other	4.397	N/A	7.976	12.373
TOTAL FUNDING	**32.845**	**0.000**	**12.305**	**45.150**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	3	3
CIVILIAN	7	184	106	297
TOTAL	**7**	**184**	**109**	**300**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	0.000	**REAL PROPERTY**	3.617
ADMIN	105.389	* NEW CAPITAL EQUIPMENT	0.017
OTHER	17.100	**EQUIPMENT**	4.069
TOTAL	**122.489**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**4**	* Subset of previous category.	

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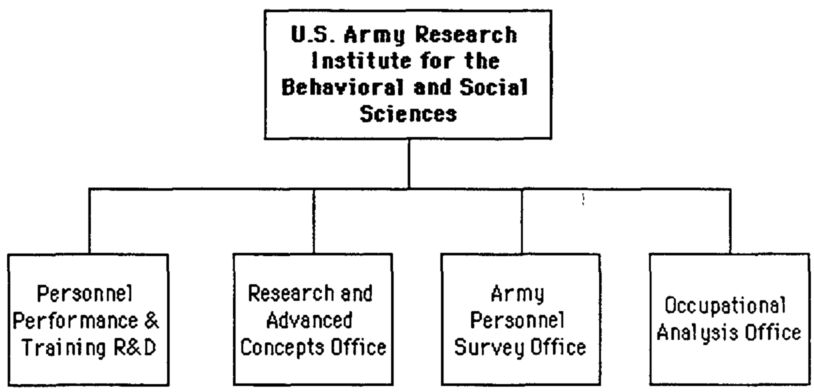
Army Research Institute for the Behavioral and Social Sciences

FY2000 Abbreviated Functional Chart - Technical Organizations



Army Research Institute for the Behavioral and Social Sciences
Alexandria, VA 22333-5600
(703) 617-8636
Director: Dr. Edgar M. Johnson
Technical Director: Dr. Zita M. Simutis

MISSION

Maximize combat effectiveness through timely research and studies in the accession, training, use and retention of soldiers. Support decision-making by Army leaders through training, leader development and soldier Research, Development, Studies and Analysis programs. ARI achieves its mission through research units located at headquarters in Alexandria, VA. and tenant locations as follow: Simulator Systems Research Unit (Orlando, FL); Armored Forces Research Unit (Ft. Knox, KY); Infantry Forces Research Unit (Ft. Benning, GA); Reserve Component Training Research Unit (Boise, ID); Rotary-Wing Aviation Research Unit (Ft. Rucker, AL); Ft. Leavenworth Research Unit (Ft. Leavenworth, KS); Scientific Research and Coordination Offices (Ft. Bragg, NC); and TRADOC Scientific Coordination Office (Ft. Monroe, VA).

CURRENT IMPORTANT PROGRAMS

1. Identify factors leading to attrition in the training base.
2. Document lessons learned from ARI research on rifle marksmanship training and performance.
3. Implement and evaluate innovative training of thinking skills at the Command and General Staff College.
4. Complete research on the implementation and assessment of specific Force XXI Training Programs with selected Army units.
5. Develop and validate a situation awareness measurement instrument for small Infantry units.

Current Cooperative Research & Development Agreements:

1. **Florida State University** - Job Skills Education Program
2. **University of Maryland** - Cooperative Research on Psychophysiological Correlates of Elite Performance
3. **SAIC** - Developing Situational Awarenes, Adaptive Command and Control Entities, and Intelligent Interfaces for Computer Generated and Semi-Automated Forces (CGF & SAF) Behaviors and Control in Distributed Interactive Simulation (SIM) Systems
4. **University of Houston** - Training & Performance of Dismounted Teams in Virtual Environments
5. **CAE Electronics** - Perform research and development on rotary wing aircrew training technology requirements and methods in networked, simulation environments.
6. **EGAD Software** - Develop an adaptation of high-end video game console technology for use as an advanced, lower cost image generator, stealth viewer, database and tools for rotary and fixed wing aviation training research.

EQUIPMENT/FACILITIES

In-house experimental facilities include laboratory and computer facilities for real-time, man-in-the-loop experimentation. Unique assets include:

- combat arms simulators
- Virtual Reality test bed
- a modular, reconfigurable flight simulator for helicopter pilot research
- simulators for UH-1Fs, AH-74A and UH-60A helicopters
- research access to SIMNET
- Battle Command Experimentation Center.

Army Research Institute for the Behavioral and Social Sciences
Alexandria, VA 22333-5600 Director: Dr. Edgar M. Johnson
(703) 617-8636 Technical Director: Dr. Zita M. Simutis

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.241	0.203	2.182	2.626
6.2	6.762	0.674	5.788	13.224
6.3	2.452	0.136	2.799	5.387
Subtotal (S&T)	**9.455**	**1.013**	**10.769**	**21.237**
6.4	0.000	0.000	0.000	0.000
6.5	0.150	0.000	0.000	0.150
6.6	0.000	0.287	4.823	5.110
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**9.605**	**1.300**	**15.592**	**26.497**
Procurement	0.056	N/A	0.000	0.056
Operations & Maintenance	1.129	N/A	0.791	1.920
Other	0.599	N/A	0.000	0.599
TOTAL FUNDING	**11.389**	**1.300**	**16.383**	**29.072**

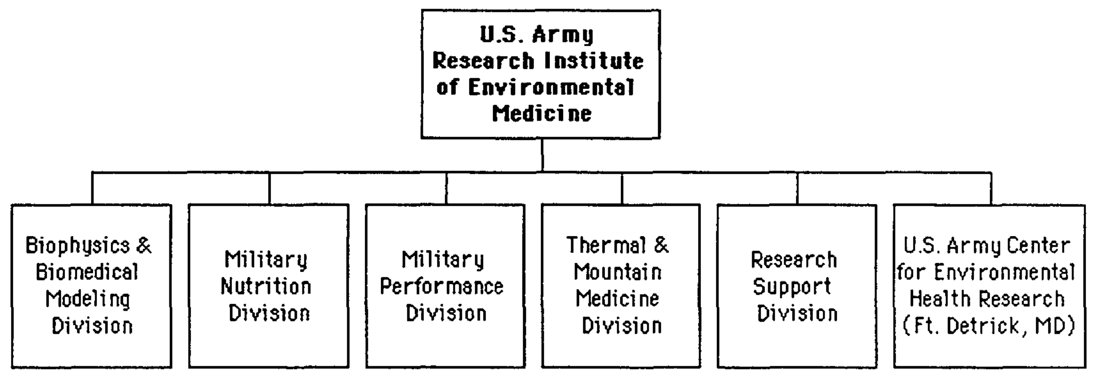
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	**SCIENTISTS & ENGINEERS**		**TECHNICAL SUPPORT & OTHER PERSONNEL**	**END STRENGTH**
	DOCTORATES	**OTHER**		
MILITARY	0	2	1	3
CIVILIAN	47	31	42	120
TOTAL	**47**	**33**	**43**	**123**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	12.325	**REAL PROPERTY**	12.978
ADMIN	53.600	* NEW CAPITAL EQUIPMENT	0.000
OTHER	3.425	**EQUIPMENT**	11.248
TOTAL	**69.350**	* NEW SCIENTIFIC & ENG. EQUIP.	5.692
ACRES	**0**	* Subset of previous category.	

Army Research Institute of Environmental Medicine

FY2000 Abbreviated Functional Chart - Technical Organizations



Army Research Institute of Environmental Medicine
Natick, MA 01760-5007
(508) 233-4811

Commander: COL John P. Obusek
Deputy Commander: LTC Beau Freund

MISSION

Conduct basic and applied research to determine how exposure to extreme heat, severe cold, and high terrestrial altitude, occupational tasks, physical training, deployment operations, and nutritional factors affect the health and performance of military personnel. Develop products, processes, and information to minimize or eliminate health risks and performance decrements of US Forces from toxic industrial/agricultural chemicals and other environmental contaminants (non-CBW).

CURRENT IMPORTANT PROGRAMS

Environmental Injury - Demonstrate efficacy of strategies to extend performance and avoid/reduce medical problems associated with military operations in cold, hot and mountainous environments. Demonstrated that body heat debt and not heat loss provides the stimulus for human cold acclimatization. Determined that NBC clothing does not increase risk of hypothermia while working in cold weather. Determined that smoking and hyper-cholesterolemia do not increase heat strain, but muscle injury and inflammatory response can increase heat strain. Determined that altitude exposure accentuates military performance decrements mediated by wearing NBC clothing.

Performance Limits - Develop and validate models to predict the effects of heat, cold, high altitude, hydration, nutritional status, and clothing and equipment on performance. Heat and cold strain prediction models have been integrated into real-time environmental sensor systems to deliver an on-line risk assessment system for training environment use. Operational Medicine Environmental Grid Application (OMEGA) now in operation at Ranger Training Brigade. Approaches being made to link OMEGA to WPSM. Basic research is gathering data and refining models of energy expenditure on various terrains, in differing climatic conditions, and for each military occupational specialty. Multidisciplinary approaches are being conducted to understand and combat the consequences of stress to military readiness and operational performance.

Nutritional Strategies - Identify and demonstrate nutritional strategies to maintain health and enhance warfighter performance. A major effort underway has focused on the development of an "experimental model," which produces physiological and cognitive effects in research volunteers which simulate those that develop in warfighters conducting sustained and/or continuous operations (SUSOPS, CONOPS). Experiments completed thus far document that the magnitude of effects produced is sufficiently large, that modeling will be suitable for use in studies to evaluate the efficacy of nutritional strategies to ameliorate those effects. Thus many studies, or at least the preliminary phases of those studies, that aim to develop nutritional strategies for use by warfighters can be accomplished without actually going into the field. Another major focus included completion of an engineering assessment and testing to adapt USARIEM's Small-Study Hypobaric Climatic Chamber for use as a respirometer. Appropriate gas analyzers, flow patterns/plumbing, software and automation platform systems for operation of the chamber as a respirometer have been selected and purchasing is largely completed. Immediate follow-on goals include validation studies using both laboratory animal studies and human research volunteers are planned for the next FY. In another major research effort, nutritional supplementation with antioxidant

CURRENT IMPORTANT PROGRAMS

mixtures has been tested for efficacy to reduce inflammatory responses and muscle soreness produced by physical exertion, and final data analyses are in progress. Refocusing of research aims and priorities will be considered during the next FY, to ensure that nutritional issues relevant to the Interim and Objective Force are addressed.

Musculoskeletal Injuries, Physical Performance, Biomechanics - Demonstrate the efficacy of methods to reduce the incidence of musculoskeletal injuries and optimize performance during military training and operations. Research is conducted to assess biochemical markers and catalog risk factors for stress fractures in the training environment and to evaluate intervention strategies for injury prevention in operational forces. A large health database which links demographic data to health outcomes has been established to allow for the evaluation of specific behavorial attributes and injury epidemiology. Special emphasis is on the biomechanical evaluation of how the body handles loads and forces generated by new equipment designs for load carriage. Recent accomplishments have been in the evaluation and modification of prototype future soldier systems (Land Warrior), the MOLLE backpack system, and combat footwear. New research will focus on the incidence and types of injuries associated with wearing head-supported devices and in the development of biomechanical models to predict adverse health and performance outcomes.

Warfighter Physiological Status Monitoring - Develop, validate, and field test ambulatory monitoring instruments and smart sensor devices that assess an individual warfighter's physiological and cognitive status in an operational environment. Develop and test data management and modeling strategies for high precision, short-term predictions of physiological status. Prototype sensors and wireless body local area network configurations are being developed and tested in soldier training environments. An Integrated Research Team has been organized to coordinate, prioritize, and direct multilaboratory, multicontractor, and academic efforts in this fast advancing effort.

Medical Chemical Research - Investigate and define mechanisms of vesicant injury. Basic research efforts use a mustard stimulant and electron microscopy to explore DNA fragmentation in human epidermis cell model. Demonstrated in a human epidermis model that exposure to half-mustard (2-chloroethyl ethyl sulfide, CEES) induced programmed cell death (apoptosis) as evidenced by cytoplasmic blebbing and chromatin clumping in electron micrographs and DNA fragmentation in histochemical analyses. Showed that the cytoprotective heat shock protein-70A was not increased by exposure to CEES, suggesting the possibility that its prior elevation could provide prophylaxis to the pathophysiological effects of CEES.

Deployment Toxicology - Develop new assays, methods and products for measuring chemical contaminants and their impact on the health and performance of US Forces in garrison and during deployment. This includes: (a) innovative strategies to assess health risks from environmental exposures to toxic chemicals, inventing screening and detection methods and animal models to assess health risks (such as resistance to disease and effects on fertility) from exposure to individual chemicals and complex mixtures; (b) rapid analysis of food and water for chemical and microbial contaminants, inventing, developing, and testing rapid, field-portable assays for contamination of food and water by toxic industrial/agricultural chemicals and human pathogens that can cause illness or death; and, (c) environmental sentinels and risk assessment, creating and developing instrumented animal models that can be released into an environment for rapid or continuous, real-time monitoring of known or unknown hazards that may affect the health of indigenous species, including humans.

CURRENT IMPORTANT PROGRAMS

Technology Transfer Program - The Institute currently has 21 Cooperative Research & Development Agreements (CRDAs) active.

In FY00, the following new CRDAs were negotiated and put in place:

- **American College of Sports Medicine** - To support editorial requirements in connection with USARIEM Senior Research Scientist's appointment as Editor-in-Chief of "Medicine & Science in Sports & Exercise."
- **Mesa State College** - To enable Mesa State to utilize the Pike's Peak laboratory facility, no fees involved.
- **Boston Dynamics, Inc.** - Load carriage simulation modeling tool.
- **Brigham & Women's Hospital** - Environmental medicine genome bank.
- **University of New Hampshire** - Attenuation of physiological strain in hot and cold environments.

EQUIPMENT/FACILITIES

Unique facilities include: high altitude/hypobaric, climatically controlled chambers able to simulate terrestrial altitudes up to 30,000 ft, high altitude performance physiology laboratory on Pike's Peak, Colorado, environmentally controlled (temperature, humidity, wind speed) physiological/performance chambers suitable for human or animal testing, fully AAALAC-I (Association for the Advancement and Accreditation of Laboratory Animal Care, International) accredited animal care and research facilities, animal biochemical and physiological laboratory, biophysical evaluation chambers for clothing and equipment, biomechanics laboratory complete with high speed motion detection and pressure sensitive equipment and force plate, Dual-Energy X-ray Absorptiometery machines for analysis of body composition, electron microscopy laboratory, psychology laboratory for assessment of variables associated with cognitive performance changes, water immersion laboratory for precise control of human core temperature, access to and primary user of the Doriot Climatic Chambers (warehouse-sized environmental chambers, owned and operated by the Natick Soldier Center). Facilities located at the US Army Center for Environmental Health Research, Ft. Detrick, MD include: AAALAC-I accredited aquaculture and aquatic toxicology laboratories, research suites to conduct in vivo and in vitro studies, analytical chemistry suites and mobile toxicology laboratories. Laboratory renovation will commence in FY01 to modernize the facilities.

Army Research Institute of Environmental Medicine
Natick, MA 01760-5007
(508) 233-4811
Commander: COL John P. Obusek
Deputy Commander: LTC Beau Freund

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.194	N/A	N/A	0.194
6.1 Other	3.460	0.041	1.018	4.519
6.2	6.609	0.074	1.826	8.509
6.3	0.790	0.002	0.356	1.148
Subtotal (S&T)	**11.053**	**0.117**	**3.200**	**14.370**
6.4	0.101	0.005	0.101	0.207
6.5	0.012	0.000	0.000	0.012
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**11.166**	**0.122**	**3.301**	**14.589**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.599	N/A	0.148	0.747
Other	5.024	N/A	0.000	5.024
TOTAL FUNDING	**16.789**	**0.122**	**3.449**	**20.360**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	21	17	26	64
CIVILIAN	22	43	34	99
TOTAL	**43**	**60**	**60**	**163**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	44.581	**REAL PROPERTY**	9.508
ADMIN	19.483	* NEW CAPITAL EQUIPMENT	0.340
OTHER	43.732	**EQUIPMENT**	27.942
TOTAL	**107.796**	* NEW SCIENTIFIC & ENG. EQUIP.	1.151
ACRES	**1**	* Subset of previous category.	

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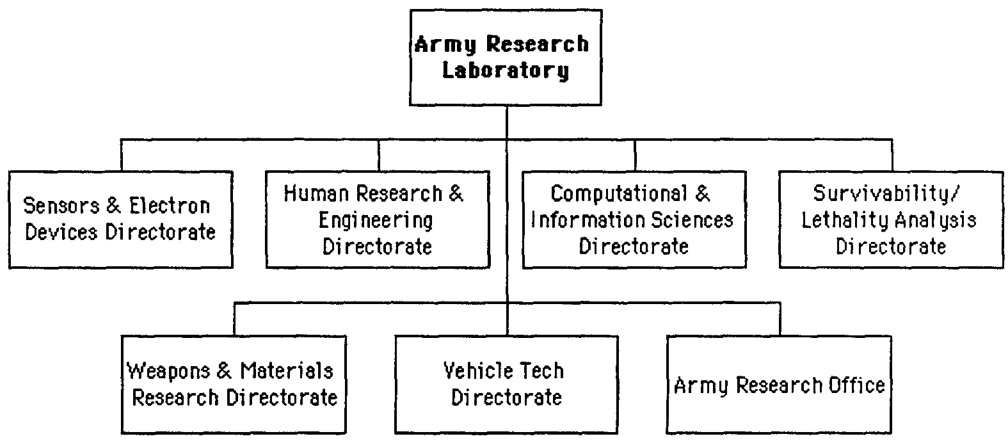
Army Research Laboratory

FY2000 Abbreviated Functional Chart - Technical Organizations



Army Research Laboratory
Adelphi, MD 20783-1197
(301) 394-1067

Director: Dr. Robert W. Whalin
Associate Director PPB: Mr. John Miller

MISSION

THE ARMY RESEARCH LABORATORY MISSION: Execute fundamental and applied research to provide the Army the key technologies and analytical support necessary to assure supremacy in future land warfare.

THE ARMY RESEARCH LABORATORY VISION: America's laboratory for the Army providing materiel readiness through innovative technology.

CURRENT IMPORTANT PROGRAMS

BASIC RESEARCH AREAS

The Army Research Laboratory has defined six major research areas that synergistically focus interdisciplinary research themes to achieve technology-enabling throughout the Army's Laboratories and Research, Development and Engineering Centers.

BIOMIMETICS: To enable development of new structural and functional materials technologically innovative approaches toward sensing and information processing with product and process lessons from nature contributing to design principles, performance capabilities, and manufacturing possibilities.

NANOSCIENCE: To achieve dramatic, innovative enhancements in the properties and performance of structures, materials, and devices that have controllable features on the nanometer scale (i.e., tens of angstroms).

SMART MATERIALS AND STRUCTURES: To demonstrate advanced capabilities for modeling, predicting, controlling, and optimizing the dynamic response of complex, multielement, deformable structures used in military and civil structures, land vehicles, weapons, and rotorcraft.

COMPACT POWER: To identify and exploit new concepts in portable power, especially in fueled systems, to increase the energy density and lower the cost of subkilowatt power sources.

MICROMINIATURE MULTIFUNCTIONAL SENSORS: To realize miniaturized, multifunctional, and multispectral sensors and sensor arrays based on novel manmade and biological material systems; on techniques for intelligent interpretation, display, and transmission of imagery; and on new fabrication techniques to provide the capabilities to monitor, image, track, predict, fuse, and report information in real time.

ARMOR MATERIALS BY DESIGN: To acquire fundamental knowledge and science-based methodology for the hierarchical design and integration of materials pertinent to the future development of armor material systems and affordable structures that incorporate signature control, novel mechanisms for energy absorption, dissipation, multithreat protection, and major reductions in weight and bulk.

CURRENT IMPORTANT PROGRAMS

APPLIED RESEARCH AREAS

The Army Research Laboratory has defined eight major applied research thrusts that will enable the technologies essential for achieving the Army Transformation goals for Future Combat Systems and the Objective Force.

SURVIVABILITY: The strategic goal is to provide innovative technologies to enable lightweight, survivable forces. Technical challenges include: 20T Future Combat Systems with the survivability of the Abrams tank; UGV autonomous mobility & intelligent behavior in unstructured environments; avoid detection by enemy forces; full-spectrum protection for soldiers at 50% current weight; reduced susceptibility to asymmetric threats. Technical approaches include: lightweight multi-functional armors and structures to defeat existing and emerging threats; active protection to defeat/degrade threats before they reach combat platforms; signature management for decreased detectability; UGV perception, intelligent control and man-machine interface/planning; crew and component protection from ballistic shock, fuel and ammunition fires, E3, and directed energy.

LETHALITY: The strategic goal is to provide innovative technologies to ensure lethality overmatch. Technical challenges include: lethality overmatch in a 20T lightweight combat vehicle; defeat all threat materiel/personnel from beyond threat weapon range; double lethality in terms of hit/kill probability; disrupt enemy's mobility and information infrastructure. Technical approaches include: EM and ETC for direct and indirect fire propulsion; insensitive high energy propellants/munitions for lethality increase and reduction in stowed munition sensitivity; advanced fire control, novel warheads & penetrators, and smart munitions; integrated aerodynamics, structures, and guidance/navigation and control; combined HPM and laser technologies for tunable target effects.

MOBILITY: The strategic goal is to provide innovative technologies to enable responsive mobility at strategic, operational, and tactical levels. Technical challenges include: reduced weight and size of vehicles; power/weight ratios; high speed movement for ground vehicles; crashworthiness of lightweight composite structures. Technical approaches include: lightweight structural materials; total structural modeling; armor system/structure integration; low drag drive systems.

SENSORS: The strategic goal is revolutionary sensor and electron device technology providing warfighters unprecedented sensing and engagement capabilities. Technical challenges include: long-range precision engagement; identification of targets beyond effective range of enemy weapons; threat identification in difficult terrain; sensing for autonomous and semi-autonomous platforms; adverse weather ISR and pilotage; identification of obscured or concealed targets. Technical approaches include: multi-spectral electro-optics imaging; distributed networked microsensors; multi-function RF systems; acoustic target ID & tracking; processing of data and information from diverse sensors.

C4I: The strategic goal is to provide Future Combat Systems with technology for decision supremacy and enhanced survivability through decisive engagements. Technical challenges include: networking thousands of warfighters and unattended nodes; speeding the decision cycle by 3 for a commander on-the-move; make information secure and survivable, given the vulnerabilities of commercial information technologies; micro-weather forecasts to enable the assessment of the extent of chem-bio attacks, support course of action analysis, and enhance accuracy of extended range weapons. Technical approaches include: devise self-organizing mobile networking protocols; devise, implement and integrate intelligent

CURRENT IMPORTANT PROGRAMS

systems that reason about terrain, weather, time and forces; integrate a suite of tools that enable collaboration and devising of a common operating picture across wireless networks; implement adaptive intrusion detection and vulnerability assessment tools for the tactical environment; implement boundary layer weather prediction models to higher spatial and temporal resolutions.

COMBAT SERVICE SUPPORT: The strategic goal is to provide technologies to enhance combat effectiveness by reducing logistics infrastructure and manpower burdens. Technical challenges include: reduce fuel consumption and increase fuel efficiency; integrated systems reliability and durability; high energy rechargeable batteries and manportable power sources. Technical approaches include: high temperature structural materials; ultra-efficient energy conversion cycles/processes; fuel cells and reforming technology; advanced coatings for extended gun life; probabilistic techniques to assess reliability and durability.

HUMAN FACTORS: The strategic goal is to maximize soldier performance in Army systems. Technical challenges include: soldier system task estimation (especially for Digitized C2); individual and team performance measurement in complex environments; linking soldier performance to combat performance in systems. Technical approaches include: supporting RDECs with focused research in ergonomic modeling and physical limits, workload, perceptual and cognitive limits, performance measurement, team collaboration and task allocation, decision making, soldier-machine interface; develop analysis tools for use by combat and materiel developers; early MANPRINT application; support all acquisition categories.

MODELING AND SIMULATION FOR SURVIVABILITY/LETHALITY ANALYSIS: The strategic goal is to devise analysis codes and techniques to decisively predict conventional ballistics effects and to assess emerging technologies. Technical challenges include: Algorithms to assess the S/L of weapon systems using evolutionary and leap-ahead technologies such as compact kinetic energy munitions, active protection systems, composite materials; verified and validated ballistics codes. Technical approach includes: techniques and codes to justify technology investments, support design trade-offs, reduce development costs and minimize U.S. casualties. Techniques and codes include fuel and ammunition ignition and sustained fires in combat systems, physics-based APS/counter-APS penetration algorithms, failure models and criteria for non-conventional advanced armors and structural materials, joint project with Navy on physics-based modeling of energetic materials.

TECHNOLOGY TRANSFER ACTIONS:

- New Cooperative R&D Agreements (CRDAs) = 7
- New Patent License Agreements (PLAs) = 1
- New International Agreements = 2
- Amendments to International Agreements = 3
- Small Business Innovation Research (SBIR) awards of $23.8M (consisting of 51 Phase I and 29 Phase II awards).

TECHNOLOGY TRANSFER PROGRAMS

ARL licensed Paratek Microwave, Inc. 5 patented inventions and 3 patent applications to bring ferroelectric materials technology to the commercial market. Four former ARL employees founded Paratek to reduce the cost and complexity of phased array antennas so they can be used in the commercial communications sector.

CURRENT IMPORTANT PROGRAMS

Two small companies receiving SBIR Phase II awards from ARL were honored as recipients of Army Phase II Quality Awards in recognition of their technical achievement, contribution to the Army, and dual-use commercialization potential.

Technology originally developed to diagnose faults with Abrams tank turbine engines, order repairs and spare parts, and keep maintenance records was transferred into a system for home blood pressure monitoring. The Remote Medical Evaluation and Diagnostics system couples an off-the-shelf blood pressure monitor to an advanced decision support system that collects, monitors and analyzes patient data by modem to the hospital or doctors office for diagnosis and treatment.

ARL S&Es received 2 of the 3 Federal Laboratory Consortium technology transfer awards won by the Army.

EQUIPMENT/FACILITIES

The ARL experimental equipment/facilities are housed at four locations:

- Adelphi Laboratory Center (ALC), Adelphi, Maryland
- Aberdeen Proving Ground (APG), APG, Maryland
- Blossom Point Research Facility, Blossom Point, Maryland
- White Sands Missile Range (WSMR), WSMR, New Mexico.

They are presented in this publication in that location breakout.

ADELPHI LABORATORY CENTER (ALC), ADELPHI, MARYLAND

ZAHL PHYSICAL SCIENCES LABORATORY

The Zahl Physical Sciences Laboratory is a 372,000 GSF state-of-the-art research facility with fully configurable general laboratory space facilitated by access points for building systems in each laboratory bay. The cornerstone of this building is the 6,400 NSF class 1000 cleanroom. Other specialty space within the Physical Sciences Laboratory includes a 336 NSF less than 1% humidity level dryroom, a 168 NSF warm room, and a 168 NSF cold room. The facility maintains a 6,000 gallon liquid nitrogen tank system and an 11,000 gallon ultrahigh purity gaseous nitrogen tank system. The building has a closed-loop high purity processed cooling water system that also feeds the demineralized and deionized water systems. It also uses its own acid and heavy metal waste treatment plant for waste disposal and two 1,500 kW diesel generators for 4 hours of emergency power. This site has a multiple containment stainless steel vacuum jacketed 48 line toxic gas system with central storage to increase the safety for the 400 building occupants and surrounding environment. The building also maintains separate personnel and chemical distribution corridors and a chemical elevator system from a central chemical pharmacy. These two main systems and many others allow the PSL to meet all 1998 OSHA safety codes. Current capabilities housed within this laboratory facility include Nanotechnology (Quantum Dots), IR Technology (QWIPs and MCT), Wide Bandgap Technology (SiC, AlN, GaN), MEMS Technology, Optical Signal Processing (VCSELS, DOE), Non-linear Optics Technology for laser protection, HF

EQUIPMENT/FACILITIES

Technology (GaAs, TeGaAs, GaN), Acoustic Sensors, Batteries, and Fuel Cells (Methanol Fuel Cell) - PEMFC. Specialized research facilities housed in this laboratory include: the Advanced Material Growth and Processing Facility, Display Materials Research Facility and the Advanced Microanalysis Facility.

ADVANCED MATERIAL GROWTH AND PROCESSING FACILITY
Housed in the Physical Sciences Laboratory, the growth facility is an advanced, centralized set of labs capable of producing cutting-edge semiconductor materials. The facility is equipped with six state-of-the-art molecular beam epitaxy (MBE) and one metal-organic chemical vapor deposition (MOCVD) systems. These systems enable the growth of advanced III-V and II-VI semiconductors such as GaAs, AlGaAs, InGaAs, InP, GaSb, GaN, and HgCdTe that are used in a myriad of optical (lasers, detectors, etc.) and electronic (FETs, thyristors, etc.) components. The growth facility provides state-of-the-art capablility in fine-line lithography (0.01 um), plasma etching, metals deposition, etc. that allow large-scale device-level processing. This facility represents a unique situation where quite extensive capabilities are located in a central set of labs.

DISPLAY MATERIALS RESEARCH FACILITY
This facility, housed in the Physical Sciences Laboratory, is for the research and development of the materials, structures, and devices which will be the basis for the displays and display systems which the Army will need for our soldiers to effectively display and assimilate data on the digital battlefield. Some capabilities for luminescent research include: facilities for low and high voltage electron beam cathode luminescence (CL), electroluminescence, photoluminescence [Vacuum Ultraviolet-Near Infra-red (VUV-NIR), Raman, Raman imaging, Near Field imaging, reflectance/transmittance], Fourier transform spectrometer, thermally simulated luminescence, and photometry. For device structures fabrication, there is an Atomic Layer Epitaxy Chemical Vapor Deposition (ALE CVD) reactor, a Radio Frequency sputtering system for electrodes, Rapid Thermal Annealing, sol-gel processing, and a multi-source system with laser ablation, sputtering, and thermal cells. A thermal evaporator with sputtering is used for the deposition of Organic Electroluminescent Devices (OLEDs).

ADVANCED MICROANALYSIS FACILITY
Housed in the Physical Sciences Laboratory, this facility provides the Army and DoD with a fully integrated capability for chemical and structural analysis of electronic materials and devices. Characterization measurements reach resolution on the atomic scale and elemental detection sensitivities to parts per billion levels. The facility contains surface and bulk characterization instrumentation including: secondary ion mass spectrometry (SIMS), Auger electron spectrometry (AES), X-ray photoelectron spectrometry (XPS), scanning electron microscopy (SEM) with associated techniques (EDX), powder and crystal X-ray diffractometers, Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), inductively coupled plasma mass spectrometer (ICP-MS), glow discharge mass spectrometer (GDMS), thermal desorption mass spectrometer (TDMS), surface profilometers and a host of state-of-the-art optical device characterization instruments. An added benefit of this facility to the Army and DoD is the use of these capabilities in failure analysis of failed critical military devices or systems.

POWER CONDITIONING RESEARCH CENTER
This facility is the laboratory setting for development and component testing for high average power and high peak power defense systems requiring advanced power conditioning components to provide an efficient, compact, and protected interface between the prime power and the power electronics load.

EQUIPMENT/FACILITIES

Within the facility is a unique collection of power supplies in the megawatt average power class, offering variable voltages up to 250 kV and direct current outputs up to 1200 amperes. A variety of modulators, capacitor banks, and power supplies are available that use high capability solid state (GTO and thyristor), thyratron, ignitron and spark gap switching. The test beds are configured for testing high average power components, power conditioning, loads such as directed energy devices, high average power devices, and also diagnostics and sensors. The extensive inventory of high voltage components permits other configurations to be arranged to satisfy the specialized requirements of facility users.

ACOUSTO-FLUIDIC TEST FACILITY

At this location, a full acoustic anechoic chamber allows the study of fluidic sensors, fluidic signal processors, and other microphone systems. Fluidic microphones, with a flat bandwidth down to a true zero hertz (DC), can be configured to be more sensitive than any commercially available microphone. In addition to the research being conducted on these fluidic microphones, they can also be used as a research tool for other programs requiring increased sensitivity and nonelectronic acoustic sensing.

INTELLIGENT OPTICS LABORATORY RESEARCH FACILITIES

This facility at the Adelphi Laboratory Center is equipped to support sophisticated studies in adaptive and nonlinear optics, advanced imaging and image processing, and laser communication for ground-to-ground applications. A variety of state-of-the-art adaptive optics, wavefront diagnostics and image processing tools are used to support advanced techniques for simulation of atmospheric turbulence effects on imaging and laser communication system performance.

MOBILE COMMUNICATIONS/NETWORKING TEST BED

The testbed equipped with the latest mobile commercial communications hardware provides a realistic environment for experimentation, test and evaluation of emerging mobile ad hoc networking protocols, software and technology required for the objective force. It provides a facility for S&Es to gather field data for communications and networking research. The testbed provides a platform for collaborative research in communication and network related areas (e.g., sensors, displays), as well as a means to demonstrate the military value of ARL research programs. The equipment and facilities are used in experimenting with robots and sensor networks.

ELECTROMAGNETICS RESEARCH FACILITY (ERF)

The ERF's mission is to develop and enhance electromagnetic (EM) effects technologies that contribute to the capabilities of Army systems to survive on the battlefields of the future. The facility supports the EM coupling and interactive studies necessary for the development of assessment and mitigation technologies for the Future Combat System and other Digital Battlefield assets. Simulated environments include Ultra Wide Band (UWB), EMP (nuclear and non-nuclear), and High Power Microwave (HPM) and the evolving electromagnetic threats of the future. The interactions with systems are studied to support analyses, code development, and full scale tests. The facility is also an excellent place to perform fundamental studies such as ground penetration, lateral wave excitation, propagation experiments, and antenna and grounding designs. The ERF building itself is constructed with a minimum of metal or conductive materials to reduce interaction with EM fields. This reduces the amplitude of fields reflecting from the building materials back into the experiment area where measurements are being made. The size of the building provides a greater distance from the experiment to the inside surface of the building. A short duration time domain signal would travel to and interact with the experimental model before the same signal would travel to the building and back. This allows an interference free measurement. An additional benefit of the distance is that the signal would lose

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amplitude as it travels away from the source, including reflection. Any measurement made in the presence of the reflected signal would have less interference the greater the distance traveled by the reflected signal. The large size also allows the placement of an antenna so the propagated field would be uniform over a complete model. This is important when modeling an incident plane wave. At the center of the facility is a large elevated bed of sand. The large sand bed allows earth interacted scale modeling. The conductivity of the sand is increased proportional to the decrease in size of the objects tested. The depth of sand allows experimentation with buried objects and a more accurate model. A measurement room is located below the sand bed. An overhead trolley allows antenna placement anywhere in the plane of the trolley beam. From these points the antenna can be rotated on an arm to reach most points in the building. This allows flexibility in source placement.

ABERDEEN PROVING GROUND, APG, MARYLAND

RODMAN MATERIALS RESEARCH LABORATORY

The Rodman Materials Research Laboratory, opened in 1998, is one of the world's largest and best equipped materials research facilities. It contains over 297,000 gross square feet of space that houses state-of-the-art laboratory facilities. The laboratory provides modern capabilities for metallurgy and surface sciences, corrosion science, as well as research in high-performance ceramics, polymers, elastomers, composites and special organic materials. Unique Non-Destructive Evaluation capabilities include Computed Tomography, Acoustography, and Stress Photonics DeltaTherm 1000 equipment. The laboratory also contains an Accelerated Environmental Aging capability to simulate end use environmental conditions and can handle test geometries from coupons to large components. Advanced microscopy equipment includes environmental scanning electron microscope, photon tunneling microscope, atomic force microscope and scanning transmission electron microscope. The laboratory contains an Army unique rubber compound processing, characterization and evaluation capability. The laboratory houses composites processing research facilities, a materials characterization facility, and an ion-implantation facility as described below.

COMPOSITES PROCESSING RESEARCH FACILITIES

Advanced low-cost, reliable processing techniques are essential to the future application of structural polymer matrix composites to Army ground vehicles, aircraft, and other materiel. ARL's state-of-the-art composites processing research facilities, such as the fully automated high-temperature (800° F) and pressure (450-psi) autoclaves provide the necessary research tools to address scientific and engineering problems in process optimization and automated process control.

MATERIALS CHARACTERIZATION FACILITY

This unique facility enables ARL's scientists and engineers to conduct highly detailed measurements of the properties of ceramics, polymers, glasses, and composites. It includes extensive state-of-the-art instrumentation for analyzing the chemical properties of materials at a wide range of temperatures, as well as a full complement of optical and electron microscopy and other electron probe instruments for microstructural analysis, x-ray residual stress analysis, and electrical, magnetic, and thermal property characterization. It also features a unique combination of surface analysis equipment.

ION IMPLANTATION FACILITY

At this facility, employees develop and demonstrate novel ion surface treatments and coating techniques for Army materiel, such as machine tools and parts subject to corrosive or high-wear environments. This technology is demonstrating significant improvements in the quality of protective coating techniques,

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such as cadmium and chromium plating. In addition, the ion-implantation process has proven to be environmentally acceptable as an alternative to cadmium, chromium, and other heavy-metal plating processes which collectively account for 90 percent of the hazardous wastes generated by all electroplating processes within DoD. A cooperative effort with the Corpus Christi Army Depot is demonstrating the effectiveness and cost benefits of ion-implanted machine tools such as taps, drills, and end-mills.

MILLIMETER-WAVE INSTRUMENTATION TEST FACILITY
Here, specialists conduct basic research in propagation phenomena, remote sensing, and target signatures over the frequency range from 8 to 300-GHz. The facility is unparalleled in the breadth and depth of its instrumentation and analysis capability. Components and test equipment are available that can be readily configured for conducting feasibility studies of sensor concepts. Supporting tools include high-speed data acquisition and analysis systems, visualization tools, and model generation for performance evaluation. Through a synergistic relationship with the U.S. Army Combat Systems Test Activity (CSTA), ARL can conduct range testing using this facility with a minimum of in-house resources.

TRANSONIC EXPERIMENTAL RESEARCH FACILITY
This facility allows the measurement of the actual flight motion of large- and small-caliber projectiles (up to 8" in diameter) under realistic pressures, densities, and velocities. It is the only facility in the U.S. capable of obtaining accurate data on large-caliber projectiles needed for input to artillery fire-control computers and firing tables.

CANNON-CALIBER ELECTROMAGNETIC LAUNCHER FACILITY
This facility features an installation that measures the launch and flight performance of electromagnetic cannons up to 30-mm in diameter. Equipped with a 2-megaJoule power supply and a range of 250 meters, it allows diagnostics of electrical, mechanical, and aerodynamic qualities of electromagnetic gun systems.

LIGHT GAS GUN FACILITY
This facility is used for sub-scale ballistic evaluations of the penetration mechanisms associated with various materials. It features 1-MeV flash X-ray radiography, high-speed photography, and laser interferometry, which provide detailed information on target-penetrator interactions. Many of the experiments are conducted using the "reverse ballistics" approach where a target is launched into a penetrator.

ROBOTICS FACILITY
This facility allows the development of robotics and related technologies. It features a 25-mph sustained-speed test track, a standardized obstacle course, and an EOD (Explosive Ordnance Disposal) robot court. Instrumentation includes a GPS position-location system, an RF position-location system, central data acquisition equipment, and a computing facility.

TARGET ASSEMBLY FACILITY
This facility provides the capability of integrating new armor concepts into actual armored vehicles. Featuring the capability of machining and cutting radioactive materials, it provides a means of fabricating and analyzing depleted-uranium armors and armors impacted by depleted-uranium projectiles.

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LARGE-CALIBER TERMINAL BALLISTICS FACILITY
This facility, unique in the U.S., can routinely conduct full-scale terminal ballistic experiments with both kinetic-energy projectiles and explosive warheads against both passive and explosive reactive armors. It features an environmentally contained test area with complete diagnostics for experimenting with munitions and armors containing depleted uranium.

SHAPED-CHARGE RESEARCH AND SHEAR-FORMING PRESS FACILITY
This is a fully instrumented outdoor facility that allows investigation of shaped-charge warheads. It features high-energy X-ray radiography that provides detailed information on shaped-charge jet break-up and particulation during terminal effects experiments. The facility can also simulate rotating warheads in spin-stabilized projectiles. The Shear-Forming Press allows rapid fabrication of liners for shaped-charge and EFP warheads.

SHAPED CHARGE / ARMOR EXPERIMENTAL FACILITY
This facility is used to evaluate armors designed to defeat "chemical-energy" warheads - both shaped-charge and explosively formed penetrators. It features four active test sites. One site is used to test reactive armor and electromagnetic armor vs. warheads of up to 7" in diameter. A second, large-scale target site, has no limit on warhead size. Both of these sites are capable of testing armors against tandem shaped-charge warheads. A horizontal x-ray site features 450-KV flash x-ray equipment and can test armors against warheads of up to 7" in diameter. A fourth site features a framing camera and can test armors against precision shaped-charge warheads of up to 3.2" diameter.

EFP TERMINAL EFFECTS RESEARCH FACILITY
This facility is a fully instrumented experimentation complex used to investigate terminal ballistic effects of explosively formed penetrator warheads, or EFPs. It features high-energy x-ray instrumentation that provides detailed information on the acceleration and deformation of EFP liners to form penetrators.

MUNITIONS SURVIVABILITY FACILITY
This outdoor experimental facility is equipped to investigate the survivability of ammunition compartments vs. chemical-energy munitions and to conduct other large explosive experiments. This facility is equipped to contain wicked fragments resulting munitions testing, and can handle detonations of up to 100 lbs.

LARGE AND SMALL CALIBER ARMOR RESEARCH FACILITY
This environmentally contained outdoor complex contains complete diagnostics to analyze the performance of classified armor technologies against kinetic-energy projectiles, including depleted-uranium armors and munitions. The large-caliber section allows testing of kinetic-energy rounds fired from gun bores of up to 7" in diameter. Flight parameters (velocity, yaw, and pitch) are measured with 450-KV flash X-ray instrumentation, and target/penetrator interaction is measured with 1-MeV X-ray instrumentation. The small-caliber section allows scale-model testing of armors vs. rounds fired from gun bores of up to 40-mm diameter. It is equipped to test small shaped-charge munitions and reactive armor. Instrumentation includes 1-MeV and 2.3-MeV flash X-ray equipment.

BALLISTIC PENDULUM FACILITY
The Ballistic Pendulum Facility is an outdoor experimental facility that is used to investigate the response of gun propellant to kinetic-energy and chemical-energy munitions and sympathetic detonation

EQUIPMENT/FACILITIES

of gun propellant.This facility features a unique combination of equipment, including CINE radiography, that provides a capability of detonating up to 100 lbs. of explosive for a single experiment.

EQUIPMENT FACILITY 6 (EF6)
This test facility gives ARL a modern, centralized complex to evaluate the effects of explosive blast and fragmentation warheads, armor-piercing incendiary and high-explosive incendiary projectile impacts, and experimental penetrators and weapons, as well as unconventional threats on aircraft components, subsystems, and complete operating fixed and rotary-wing aircraft. This testing capability benefits our participation in the DoD Joint Live-Fire Army-Air Force Program, as well as future developmental, specification, and live-fire test and evaluation associated with major Army aviation and anti-aircraft systems. In addition to Army test requirements, EF6 supports Air Force and Navy-sponsored anti-aircraft warhead lethality evaluations and Aircraft Battle Damage Repair techniques. Specialized test resources and facilities at EF6 include a blast pad for the valuation of the effects of large blast/fragment warheads (of up to 100-lb of high explosives) on operating helicopters or fixed-wing aircraft, a cove red full-scale dynamic turbine engine and helicopter drive train test pad, indoor and outdoor small-to-medium-caliber ballistic ranges for component and subsystem testing, EPA-approved fuel systems test capability, helicopter rotor-blade static loading fixture, remotely operated helicopter ground test tie-down, mobile airflow generator capable of 500 knots of airflow directed at targets, and a centralized test preparation and control/instrumentation building. A dedicated full-scale dynamic structural test building with ballistic capability was also constructed within EF6.

ELECTROMAGNETIC COUPLING FACILITY (EFC)
The EFC supports survivability analyses of developmental weapon systems and assists materiel developers in hardening systems to withstand the effects of electromagnetic pulse (EMP) and other electromagnetic environments. The facility obtains electromagnetic coupling and response measurements through two experimental techniques, radiated continuous-wave and current injection.

The Continuous-Wave Instrumentation System (CWIS) radiates sinusoidal electromagnetic fields at selected frequencies between 10-kHz and 1-GHz using two antenna systems, a 1000-ft horizontal dipole and a log-periodic antenna with a large clear 2500-m^2 test volume. The ECF also features current injection devices capable of producing a broad range of double-exponential and dampened sinusoidal waveforms, including sources that meet MIL-STD-188-125 requirements. Data measured by both techniques are transmitted, via fiber-optic link and network analyzers, to the facility's instrumentation trailer. These computational resources determine the time-domain response to transient electromagnetic radiation, including the EMP threat and duplicate threat-level system response to EMP or other transient electromagnetic coupling.

MOBILITY/PORTABILITY OBSTACLE COURSE
This calibrated obstacle course has become an Army standard for measuring the effects of various physical load configurations on soldier mobility and physiological functions. The course consists of hard surfaces and wooded march areas and obstacles that require the soldier to run, jump, crawl, and climb. Objective course data are augmented with real-time physiological data. Features of the course include: Interactive system software for information identification, storage and retrieval, integrated computerized status display for real-time trail status, and data collection software to compile time, intra-obstacle time, and total elapsed time.

EQUIPMENT/FACILITIES

SMALL ARMS EXPERIMENTAL FACILITY

The Small Arms Experimental Facility is a 600-meter, computerized state-of-the-art facility for examining soldier-weapon performance. It consists of multiple stationary and moving targets, controlled from a computer-equipped command and control center. This experimental facility permits the engagement of targets at a wide variety of distances, target exposure times, and angles. It features four firing lanes with target exposures from 10 to 550 meters. These firing lanes can be operated simultaneously with different target scenarios or collectively from a central firing point. Each lane has five targets. Two targets each at 10 and 25 meters for firing personal defense weapons and three targets each at 50, 75, 100, 150, 200, 250, 300, 400, 500, and 550 meters for rifle firing. Specially designed targets and pneumatically operated target mechanisms are also featured. The computerized command and control center can present programmed arrays of targets at any distance, time interval, and sequence. The computer system has a software package that records and reduces range events such as targets presented, target time, target hits, shots fired, and time of shot.

HIGH-PERFORMANCE COMPUTING RESOURCES

ARL hosts one of four DoD Major Shared Resource Centers (MSRC) for High Performance Computing (HPC) in the DoD High Performance Computing Modernization Program (HPCMP). The ARL MSRC facility features state-of-the-art, scalable parallel architectures and large vector-parallel systems supporting both classified and unclassified missions throughout the DoD Research, Development, Test and Evaluation (RDT&E) community. The ARL MSRC, the Army High Performance Computing Resource Center (AHPCRC) and other ARL internal associated research provides leadership in computational science; the design, development and implementation of innovative high speed networking technologies; and scientific visualization.

INFORMATION ASSURANCE CENTER

The Center acts as a "fusion" point for bridging the ARL research in tactical and operational IA areas; and the development/assessment of improvements to monitoring and analysis processes, to include new monitoring tools and testbeds. The IAC includes the Local Computer Incident Response Team (LCIRT) for AMC, the Computer Security Incident Response Team (CSIRT) for ARL, and the HPC Computer Emergency Response Team (CERT) for DoD. The IAC significantly improves the ARL/AMC/DoD HPC ability to protect its infrastructure from unauthorized access, illicit exploitation, component damage and denial of service to authorized users.

BLOSSOM POINT RESEARCH FACILITY, BLOSSOM POINT, MARYLAND

SPECIALIZED ENVIRONMENTAL MEASUREMENT AND CHARACTERIZATION CAPABILITIES

ARL has developed and assembled a suite of specialized meteorological equipment that will enable the Army to address future requirements for a detailed characterization of the atmospheric boundary layer, the lower 1-3 km, to support both research for model development and validation as well as data collection supporting the evaluation of prototype military systems. This equipment is located at two major locations, Blossom Point Research Facility, MD and White Sands Missile Range, NM and provides ARL with the opportunity to take advantage of a variety of environmental conditions and geographic terrain. This suite of measurement capabilities includes specialized visible and infrared transmissometers used to measure the opaqueness of the atmosphere and to evaluate Army RSTA sensors and weapon systems operating in degraded and battlefield-obscured atmospheres. In addition, the Blossom Point Facility contains two infrasonic arrays running 24 hours a day/seven days. The arrays

EQUIPMENT/FACILITIES

monitor the environment for acoustic sources generating signals below 10 Hz. This allows a "quick look" of signal images detected and the direction of arrival from which the sound originated. The system also includes a geophone to monitor seismic events that could be generating the infrasonic signals.

MOBILE ACOUSTIC SOURCE (MOAS)
MOAS is located at the Blossom Point Research Facility, MD. It is a system with environmental capabilities that exist in no other system in the world. The MOAS is a pneumatic loudspeaker system that allows scientists to verify acoustic models with atmospheric effects. The system is a true exponential horn, 56-ft long, with full fidelity from 10 to 500-Hz. It will generate sound sufficient for testing acoustic propagation of sources up to 15-km away. Other features include the following: (1) it is transportable, mounted on an expandable flatbed trailer, (2) it can develop 20,000 acoustic watts of power, or over 150-db, and (3) it may be remotely controlled with fail-safe software to ensure safe operation. The MOAS can reproduce realistic signals simulating any sound at various ranges and under controlled conditions, and it can broadcast single tones, multiple tones, or tape playbacks.

WHITE SANDS MISSILE RANGE, WSMR, NEW MEXICO

ULTRA WIDEBAND (UWB) SYNTHETIC-APERTURE RADAR (SAR) TESTBED
A mobile UWB SAR testbed, featuring a 150-ft measurement system, is used to support vehicle-mounted ground-penetrating radar developments, including mine detection systems. The UWB radar on a 150-ft boom lift allows for collection of two-dimensional apertures to support three-dimensional image formation for improved target detection and identification.

ELECTROMAGNETICS ANALYSIS FACILITY (EMAF)
This facility conducts full-scale investigations of the vulnerability of weapon systems to electronic warfare, including radio frequency countermeasures (RFCM), millimeter-wave countermeasures, and high-power microwaves (HPM). Electromagnetic susceptibility experiments use three anechoic chambers: the primary investigation anechoic chamber, a 94-ft long, 32-ft wide, and 25-ft high chamber; and two smaller chambers, one used for RFCM and one for millimeter-wave CM. Featuring externally modulated high-power amplifiers, the EMAF offers the capability to continuously sweep from 100-MHz to 18-GHz and to generate pulsed RF of up to 1-MHz and pulsed waves from 50-ns to continuous-wave. The facility can also generate AM, FM, and noise-modulated RF environments to expose the system under investigation to a comprehensive set of conditions that may be encountered in a battlefield. Resident state-of-the-art computational resources are available to provide equipment automation and real-time data analysis and storage. Also featured is a computer-controlled RF-threat emulator that provides complex, high-fidelity single RF-threat radar waveforms for the RFCM investigations.

ELECTRO-OPTICAL COUNTERMEASURES MISSILE FLIGHT SIMULATION FACILITY
This hardware-in-the-loop missile flight simulator evaluates the effectiveness of EO air defense missile systems in CM environments. The simulator includes major portions of actual missile-guidance and control hardware with software embedded in the simulation loop. Real-time representations are solved using both digital and analog computers for missile dynamics in six degrees of freedom and target motion in three degrees of freedom. A multiprocessor digital computer solves the missile aerodynamics and propulsion and the relative target-missile geometry. The analog computer models subsystems with bandwidths too high to allow real-time digital solution, such as the wing servo or gyro transfer function. A second digital computer functions as the simulation controller and supervises the real-time trajectory

EQUIPMENT/FACILITIES

and field-of-view displays hosted on two PCs. The primary output from the simulation is miss distance at the point of closest approach to the target, a criterion from which the overall effectiveness of a CM technique may be assessed. Further processing of the miss distance into a digital end-game model can yield probability of hit (i.e., missile lethality) against specific threat aircraft.

ELECTRO-OPTICAL DATA ACQUISITION AND TRACKING SYSTEM (EDATS)
The EDATS provides a unique capability of dynamically tracking and measuring target signatures during EW missile firing experiments. It consists of a 35-ft instrumentation van integrated with an automated tracking pedestal capable of controlling the operation of six Electro-optical missile seekers in a captive track arrangement. Data collected from the captive seekers can be recorded for post-mission analysis. Video documentation of seeker responses to the EOCM environments aids quick-look analysis. The EDATS is equipped with infrared through ultraviolet spectrometers, radiometers, and imagers to obtain signatures of targets, countermeasures, and backgrounds. Automatic target tracking is achieved with a highly modified Chaparral AN/DAW-1B missile seeker or digital/analog outputs from the control computer. Manual target tracking is also available via a joy-stick that operates the track mount (either remotely or directly by telescope optics). The motion of the track mount during a data run can be recorded to a computer file, which can be played back through the track mount to collect background signature data across the same path. The signature measurements of the background can then be subtracted from the target-plus-background data file to achieve target-only measurements.

ACOUSTIC/SEISMIC COUNTERMEASURE VEHICLE
ARL operates a modified 5-ton stake-bed truck that can evaluate acoustic and seismic countermeasures by functioning as an acoustic/seismic decoy and an acoustic jammer. The vehicle houses an acoustic loudspeaker system, consisting of a 12-kW power generator, subwoofer cabinets, and power amplifiers that can reproduce any signal within a frequency range of 40 to 200-Hz. The vehicle also tows a 750-lb tank sprocket used to generate seismic energy that produces spectral lines similar to those of ground combat vehicles but at a smaller magnitude. To simulate a moving ground vehicle target, the vehicle radiates a pre-recorded target signature as it travels along the ground. To simulate an acoustic jammer, it radiates broadband noise designed to protect accompanying target vehicles by masking their acoustic signatures. The vehicle is currently being used to examine the effects of decoying and jamming on the Wide-Area Mine System - a system that relies on the acoustic and seismic energies emanating from a ground combat vehicle to engage it as a target.

AIR DEFENSE ELECTRONIC WARFARE FACILITY
This laboratory provides ARL with quick-reaction capability for the implementation of EW techniques to ensure that all elements of the EW threat required for the vulnerability assessment process are addressed. Specialized hardware is developed and fabricated at this facility for the field experiments associated with surveillance, tracking, and guidance functions of Army systems. The facility supports a wide variety of special-purpose equipment, including airborne and ground-based RF jammers, EOCM equipment, passive RFCM equipment, and state-of-the-art field measurement systems. Although primarily developed to support EW vulnerability analyses, these resources have wide application and are routinely used by the other services as well as the international community.

THE PROFILER TESTBED
This testbed is located at White Sands Missile Range, NM. It is the only mobile system in the world today that combines a real time remote sounding capability with a near real-time mesoscale model for analysis and forecasts over domains of up to 500 x 500 km, all contained in a HMMWV shelter with

EQUIPMENT/FACILITIES
trailer for the wind radar. Remote sensors include the wind radar, a passive microwave radiometer for temperature profiles (plus total water vapor and total liquid water), and a meteorological satellite receiver for both NOAA and DMSP satellites. Data from the several remote sensors and a small portable ground station are used to produce a local combined sounding from the surface to as high as 30 km. The system also contains a communications satellite receiver for obtaining data from weather centers (e.g., AFWA). The system can generate a local sounding as frequently as every 5 minutes. The system can serve as a testbed for new algorithms and experimental hardware that could further reduce the logistics footprint while increasing support of increased lethality and survivability for the Objective Force and the Future Combat System. Examples include neural network retrievals of profiles of atmospheric variables using met satellite and ground based data as input and new algorithms for use in the mesoscale model. The system also may be used to support evaluation of prototype military systems where rapid refresh rates are required for local soundings or mesoscale areas. The Profiler is a new technology area by itself, and can be used to evaluate other new technologies.

Army Research Laboratory
Adelphi, MD 20783-1197
(301) 394-1067

Director: Dr. Robert W. Whalin
Associate Director PPB: Mr. John Miller

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	29.647	9.898	163.344	202.889
6.2	96.120	1.090	103.412	200.622
6.3	14.253	0.525	57.764	72.542
Subtotal (S&T)	**140.020**	**11.513**	**324.520**	**476.053**
6.4	5.034	0.080	8.100	13.214
6.5	2.708	0.048	4.856	7.612
6.6	31.607	0.760	56.132	88.499
6.7	5.779	0.103	10.538	16.420
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**185.148**	**12.504**	**404.146**	**601.798**
Procurement	3.132	N/A	43.181	46.313
Operations & Maintenance	27.347	N/A	28.732	56.079
Other	4.903	N/A	7.770	12.673
TOTAL FUNDING	**220.530**	**12.504**	**483.829**	**716.863**

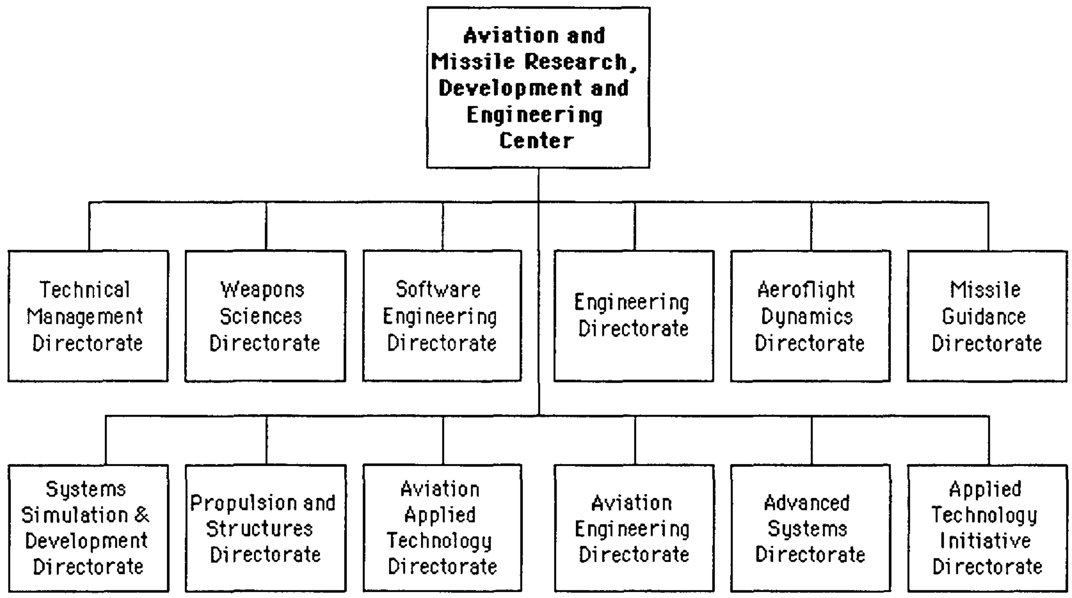
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	4	27	22	53
CIVILIAN	360	885	817	2062
TOTAL	**364**	**912**	**839**	**2115**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1356.000	**REAL PROPERTY**	697.141
ADMIN	978.000	* NEW CAPITAL EQUIPMENT	0.141
OTHER	721.000	**EQUIPMENT**	610.675
TOTAL	**3055.000**	* NEW SCIENTIFIC & ENG. EQUIP.	28.769
ACRES	**5345**	* Subset of previous category.	

Aviation and Missile RDEC

FY2000 Abbreviated Functional Chart - Technical Organizations



Aviation and Missile RDEC
Redstone Arsenal, AL 35898-5000
(256) 876-3322

Director: Dr. William C. McCorkle
Deputy Director: Herbert M. Carr, COL, AD

MISSION

Provide "one-stop" engineering support to all life cycle phases as required to achieve technologically superior, safe, and supportable Army aviation and missile systems. Plan and execute the Army rotorcraft and missile systems Science and Technology programs. The AMRDEC has the responsibility to plan and, in most cases, execute the fundamental basic research, exploratory development, and advanced development programs supporting DoD-wide rotorcraft needs in the areas of aeromechanics, propulsion, structures, reliability and maintainability, survivability, weaponization, avionics mission equipment, and systems integration/simulation. AMRDEC provides the technical expertise to enable the services to be smart buyers and users of missiles, rockets, helicopters, unmanned vehicles and their unique technologies and engineering disciplines. These include system-unique command and control, directed energy, propulsion, modeling and simulation, structures, controls, and sensor systems. As such, the AMRDEC is an essential part of the acquisition process.

CURRENT IMPORTANT PROGRAMS

Compact Kinetic Energy Missile (CKEM) Technology - This project demonstrates the compact kinetic energy missile technology necessary for future kinetic energy weapons for the Future Combat Systems (FCS) and the Objective Force. CKEM will match the lethality of the LOSAT while reducing the LOSAT take off weight by 40-50%, missile diameter by 20%, minimum range to peak velocity by 40-50%, and provide the maneuver capability required to destroy attacking fixed and rotary wing aircraft. This concept is being designed to be compatible with the LOSAT target acquisition and tracking system and could be compatible with the fire control system for close combat and short range air defense missions.

Future Missile Technology Integration (FMTI) (formerly known as The Army Combined Arms Weapon Systems (TACAWS)) - This project demonstrated advanced tactical missile technologies including seekers, propulsion, airframes, warheads, and guidance and control. The project demonstrated lightweight multi-role missile technology in support of ground-to-ground, ground-to-air, air-to-air, and air-to-ground missions. Combined, flexible capability allows one system or variants of one system to replace many, realizing potential extensive savings in development costs, logistics, training, etc. The FMTI demonstration program has transitioned technology to the Modernized Hellfire/Common Missile.

Low Cost Precision Kill (LCPK) 2.75" Guided Rocket - This project provides for demonstration of a low cost, accurate (1-m CEP) guidance and control retrofit package for the 2.75" Hydra-70 rocket that provides a stand-off range for a high single shot probability of hit (Ph > or = 0.7) against the long range target, exceeding the current unguided 2.75" rocket baseline by 1 or 2 orders of magnitude and thereby providing a 4 to 1 increase in stowed kills at 1/10 the cost per kill compared to current guided missiles. The increased accuracy will minimize collateral damage, reduce risk of fratricide, and will reduce mission times and sorties resulting in increased system survivability. A retrofit guidance package approach based on a solid state (strapdown) mechanization of semi-active laser (SAL) guidance, will be developed and tested, with user participation, to assure the most cost effective transition to EMD.

CURRENT IMPORTANT PROGRAMS

Counter Active Protection Systems (CAPS) - This project develops and demonstrates technologies which can be applied to Anti Tank Guided Weapons (ATGW) for improving their effectiveness against threat armor equipped with Active Protection Systems (APS). Current technology development is concentrated in the following areas: Radio Frequency (RF) Counter-measure (RFCM) technology for jamming or deceiving APS sensors used for detection, acquisition, and tracking; warhead integration and ballistic hardening of ATGW to reduce vulnerability to fragment impact.

Rapid Force Projection Demonstration - The integrated system of systems concept of the ACTD provides lightweight, responsive precision fires to destroy threat armor forces during day, night, and adverse weather. This ACTD evaluated the value added by the insertion of these new technologies into the force structure of an existing light unit in a lift constrained environment. The inserted systems consisted of forward sensors (hunters), advanced C2, and a suite of standoff killers. This program has successfully demonstrated the concept in a major field experiment and is in the residual phase.

Loiter Attack Munition-Aviation (LAM-A) - This effort will demonstrate, through flight simulations and component developments, technologies for a long range (>30 Km) weapon system for maneuver forces (with potential air defense and artillery applications). These technologies will provide enhanced sensor-shooter connectivity, continuous in-flight autonomous feedback of target coordinates to local field commanders, minimized timeline for placing weapons on target, and battlefield damage assessment with last images before impact as well as demonstrate automatic target recognition (ATR) and man-in-the-loop target acquisition and engagement concepts.

Compact Aerial Vehicle-Shooter Linker (CAV-SL) - This effort will provide a small, easy-to-operate, inexpensive UAV which will be organic to small units such as a tank platoon. CAV-SL will provide information for targeting, battle damage assessment (BDA), and fratricide avoidance.

Future Combat System Missile Fire Control (FCS-MFC) - The program will develop an open architecture fire control system for the Future Combat System (FCS). This architecture will provide the intelligence needed to implement "Plug and Fight" (P&F) capability for the FCS family of vehicles. P&F capability allows any missile to be loaded onto any FCS vehicle and the fire control system will automatically reconfigure itself to fire the loaded weapon(s). The architecture will be such that robotic vehicles (UGVs and UAVs) can be controlled from manned vehicles, allowing distributed targeting and target engagement from distributed weapons. Therefore, the same fire control architecture can be used for both manned and unmanned elements of FCS, allowing significant savings in software costs. In addition to missiles, the fire control system will also be able to handle fire control requirements for guns. The program is being coordinated with ARDEC and TARDEC to ensure that requirements associated with gun fire control and armored crew human factors (Soldier-Machine Interface) are being addressed.

Future Attack Loitering CONcept (FALCON) formerly known as Multimode Airframe Technology (MAT) and Long Range Fiber Optic Guided Missile (LONGFOG)) - This program provided technology for a 40 km day/night, multiple and high value time sensitive point target strike capability while inflicting minimum collateral damage. The FALCON system provided the capability to select priority targets after launch, conduct limited man-in-the-loop BDA, and provide target area reconnaissance in addition to target attack by means of loitering over areas of interest.

CURRENT IMPORTANT PROGRAMS

The Aeromechanics S&T program is organized into three Science and Technology Objectives (STOs), Advanced Rotorcraft Aeromechanics Technologies (ARCAT), Variable Geometry Advanced Rotor Technology (VGART), and Low Cost Active Rotor (LCAR). These STOs will contribute to rotorcraft system payoffs in range, payload, cruise speed, maneuverability/agility, reliability, maintainability, and reduced operating costs. The ARCAT program will use on-blade active controls to increase rotor blade performance and aerodynamic efficiency and reduce noise, blade loads, and vehicle vibration. The VGART program will employ a variable geometry rotor system (which is an option for the Future Transport Rotorcraft) to reduce vibration and increase maximum blade loading. The technology readiness level will improve from a four to a five for ARCAT and VGART. The LCAR program has the goal of transitioning to rotor on-blade control for a no-swashplate helicopter demonstration program. The no-swashplate helicopter has great potential for reduction in operating costs, as well as improved performance. The technology readiness level will improve from a two to a four for LCAR.

The Helicopter Active Control Technology (HACT) STO will demonstrate the next generation flight control system for rotorcraft. The HACT program will use fly-by-wire/light digital control as part of the vehicle management system to improve rotorcraft control and handling qualities. Through the use of task tailored control laws, the propulsion, utility, and mission subsystems will be integrated with flight control to improve flight path guidance. The results include improved weapons pointing accuracy and increased aircraft agility and maneuverability. The technology readiness level will improve from a three to a seven for HACT.

The Rotary Wing Structures Technology (RWST) STO will include fabrication and demonstration of advanced lightweight tailorable structures and ballistically tolerant airframe configurations. The RWST program will improve structural loads prediction accuracy and reduce manufacturing labor costs. Aircraft structural components will be produced from composite materials using automated manufacturing processes to improve aircraft assembly procedures. The extensive use of composite structures will contribute to aircraft goals of increased range or payload lift capability, increased reliability and maintainability, and reduced operating costs. The technology readiness level will improve from a three to a six for RWST.

The Subsystems S&T program is organized into two technologies, survivability and prognostics/diagnostics. The survivability technology area is focused on the Rotorcraft Enhanced Survivability Technologies (REST) STO, which will demonstrate substantial reduction in aircraft signatures (infrared/electro-optic/visual). The REST program will use infrared suppression concepts to reduce engine exhaust signatures and advanced camouflage and low-glint canopy materials to reduce electro-optic/visual signatures. The goal of REST is to provide a significant improvement in survivability to the aircraft and crew. The technology readiness level will improve from a three to a five for REST. The prognostics/diagnostics technology area is focused on the Joint Advanced Health and Usage Monitoring System (JAHUMS), which is an Advanced Concept and Technology Demonstration to improve in-flight safety and reliability of helicopters. The JAHUMS program will provide reduced life cycle costs, improved system safety and performance, and streamlined maintenance and logistics processes in the Army and Navy helicopter communities. The technology readiness level will improve from a five to a seven for JAHUMS.

The Rotorcraft Drive System for the 21st Century (RDS-21) STO will integrate emerging technologies in materials, structures, mechanical components, dynamics, acoustics, lubrication, and manufacturing processes to improve the performance and affordability of large rotorcraft drive systems.

CURRENT IMPORTANT PROGRAMS

The RDS-21 program goal is to provide efficient power transfer with a minimum number of components. In achieving that goal it is expected that improvements will be made in aircraft lift capability and reductions in noise, operating costs, and manufacturing costs. Components will be built and tested with the results compared to computer models of the rotorcraft drive system. The technology readiness level will improve from a five to a seven for RDS-21.

The Integrated High Performance Turbine Engine Technology (IHPTET) Joint Turbine Advanced Gas Generator (JTAGG) Phase III STO will increase engine performance capability for turbo shaft/turboprop class of engines for helicopters. This goal will include a significant reduction in specific fuel consumption and an increase in aircraft lift capability. The IHPTET/JTAGG Phase III program will integrate and demonstrate the benefits of advancements in structures, controls, and aerodynamics to increase rotorcraft range and reduce the operating costs. The technology readiness level will improve from a five to a seven for IHPTET/JTAGG Phase III.

The Airborne Manned/Unmanned System Technology Demonstration (AMUST-D) STO will use simulation and a flight program to test the control mechanisms, intelligent linkages, and integration architectures in teaming manned and unmanned aircraft systems. This teaming should increase the combined arms team's battlefield effectiveness and survivability while reducing hunter-to-shooter timelines. The system will contribute to a faster and clearer battlefield picture and real-time battle damage assessment. The technology readiness level will improve from a three to a seven for AMUST-D.

Cooperative Research and Development Agreements (CRDAs):

COMPANY: Macroni Aerospace Systems, Inc.
DURATION: 11/99 through 12/01
SUBJECT: Hellfire Anti-Radiation Homing (HRH) Adjunct Receiver and Counter-Active Protection System (CAPS). This research will have direct commercial applications such as emitters, aircraft navigation, and field strength environmental survey of radiation fields.
PAYOFF: Significant risk reduction for the Modernized Hellfire Program.
MONIES RECEIVED FROM THIS CRDA: $50,000.00

COMPANY: Lockheed Martin Corporation
DURATION: 11/99 through 12/01
SUBJECT: Kinetic Energy Missile Technology (KEMT)
PAYOFF: Commercial applications within systems utilizing guidance and control systems and direct foreign military sales.

COMPANY: Lockheed Martin Aerospace
DURATION: 4/00 through 4/01
SUBJECT: Software Program Conduit
PAYOFF: Control flight control law design tasks associated with a high performance fighter configuration.

COMPANY: OPTS, Inc.
DURATION: 4/00 through 7/03
SUBJECT: Microelectromechanical Support Element (MEMS). This research will have direct commercial applications such as optical communications links, miniature actuators, optical switching,

CURRENT IMPORTANT PROGRAMS

and sensors.
PAYOFF: Reduction in costs, increase in reliability and performance of optical elements used in Army missile and optics systems.

COMPANY: Aegis Research Company
DURATION: 5/00 through 4/02
SUBJECT: Photonic Sensor Components
This research will have direct commercial applications such as telecommunications, commercial-grade guidance and control systems, chemical and biological sensors, high-speed interconnect, and parallel optical processors.
PAYOFF: Development of low cost electro-optic sensors.
MONIES RECEIVED FROM THIS CRDA: $3,000.00

COMPANY: Atlantic Research Corporation
DURATION: 6/00 through 12/03
SUBJECT: Tactical Missile Resource Recovery and Recycling. This research will have direct commercial application in the technical field of or application of demilitarization of tactical missiles and rockets with reutilization of components and by-products.
PAYOFF: Reuse of recovered materials.

COMPANY: Sikorsky Aircraft Company
DURATION: 6/00 through 6/01
SUBJECT: Automatic Flight Control System (AFCS)
PAYOFF: Reduction in the production cost of military systems.
MONIES RECEIVED FROM THIS CRDA: $69,300.00

COMPANY: BAE
DURATION: 7/00 through 12/01
SUBJECT: Wind Tunnel Testing Low Cost Precision Kill Technology that investigates advanced missile concepts and will have commercial applications as laser seeker configurations, missile technology utilizing small diameter missiles launched from existing small launch tubes.
PAYOFF: Long-range weapons development, i.e., Advanced Fire Support System (AFSS) and modernized Hellfire missiles.
MONIES RECEIVED FROM THIS CRDA: $178,658.00

COMPANY: Advanced Rotorcraft Technology, Inc.
DURATION: 8/00 through 8/05
SUBJECT: Rotorcraft Comprehensive Analysis System
PAYOFF: Reduction in the production cost of military systems.

COMPANY: Lockheed Martin Missiles & Fire Control - Orlando
DURATION: 8/00 through 8/01
SUBJECT: Common Simulation Framework
PAYOFF: This research will have direct commercial applications in the technical field of or application area of direct foreign military sales (DFMS).

CURRENT IMPORTANT PROGRAMS

COMPANY: The Boeing Company
DURATION: 9/00 through 8/01
SUBJECT: Low Cost Precision Kill (LCPK). Advanced missile concepts that research will have direct commercial applications such as precision guidance of small free rockets.
PAYOFF: Securing concept that can be extended to missiles of various diameters, such as MLRS, STINGER, etc.

COMPANY: Talley Defense Systems, Inc.
DURATION: 9/00 through 8/01
SUBJECT: High Performance Environmentally Friendly Minimum Signature Propellant Development (EFMSPD). This research will have direct commercial application of propulsion components for civilian space launch, weather research and sounding rockets.
PAYOFF: To open the technology market for composite propellants.

COMPANY: Boeing
SUBJECT: Simulation Use of RPA Cockpit in Manned/Unmanned Aerial Platform Operations on the Digitized Battlefield

COMPANY: Carson Services, Inc.
SUBJECT: Helicopter Composite Main Rotor Blade Specimen Testing

COMPANY: Carson Services, Inc.
SUBJECT: Material Charactrization of Composite Rotor Blades

COMPANY: Sikorsky Aircraft
SUBJECT: Advanced H-60 Engine Exhaust Supression Demonstration Program

COMPANY: Robertson Aviation
SUBJECT: Testing of External Fuel Tank for US Army Helicopters for Crashworthiness & Seal Characteristics

COMPANY: Racal Avionics, Inc.
SUBJECT: Evaluation & Demonstration of PRISM2 Primary Selectable Mission Support System

COMPANY: Sikorsky Aircraft
SUBJECT: Aviation Manned/Unmanned Systems Technology Requirements Definition

COMPANY: Allied Signal Aerospace
SUBJECT: Helicopter Laser Radar

COMPANY: Northrop Grumman Corporation
SUBJECT: Tracker XXI Demonstration Program

COMPANY: Boeing
SUBJECT: Rotorcraft Operational Capabilities Study

CURRENT IMPORTANT PROGRAMS

COMPANY: Advanced Rotorcraft Technology, Inc.
SUBJECT: Use and Support of Rotorcraft Comprehensive Analysis System (RCAS)

COMPANY: Sikorsky Aircraft
SUBJECT: S-92 flow studies using CFD methods for predicting the change in drag

COMPANY: Microbotics
SUBJECT: Development and application of artificial intelligence technology and sensors to Army vehicles

COMPANY: Boundary Layer Research Inc.
SUBJECT: Research collaboration on the strake invention as it is being applied to the UH-1

COMPANY: Carson Helicopters
SUBJECT: Design and test collaboration for an advanced main and tail rotor system for the S-61.

COMPANY: Boeing-Philadelphia
SUBJECT: Development and testing of MIDAS (Beta Testing) use for evaluations of civil tilt rotor

COMPANY: Boeing-Seattle
SUBJECT: Use of CONDUIT in support of Joint Strike Fighter

COMPANY: Boeing Helicopters Philadelphia
SUBJECT: Use of CONDUIT in Support of Boeing Digital SCAS Development

COMPANY: Lockheed Martin
SUBJECT: Use of CONDUIT Control to optimize Tilt Rotor Handling

COMPANY: Bell Helicopter
SUBJECT: Use of CONDUIT Control to optimize Tilt Rotor Handling

COMPANY: Boeing-Long Beach
SUBJECT: Use of CONDUIT in Support of Flying Qualities Research

COMPANY: Kaman Helicopter
SUBJECT: Application and use of CONDUIT Control Systems Design to optimize design of the SH2G and unmanned KMAX (BURRO) AFCS

COMPANY: Northrop Grumman
SUBJECT: Use of CONDUIT to support VTUAV project development.

The RDEC Director presented nineteen (19) Domestic Technology Transfer Awards. These awards were given to each outstanding contributor for their effort to bring AMRDEC technologies to the commercial market place.

EQUIPMENT/FACILITIES

Propellant Aging and Mechanical Properties Facility - This is the most modern facility in the world dedicated to solid rocket motor structural integrity and service life extension investigation. Completed in 1988, it meets DoD's latest safety requirements for handling hazardous propulsion materials.

Gel Propellant Rheology Facility - This facility is used to determine rheological properties of gelled propellants over the full range of the Army operational temperature limits and for shear rates equivalent to those imposed on the gels by engine injectors. This information is required to minimize the volume and weight of gel propulsion systems.

Ducted Rocket Test Facility - This is the most modern, economical, sub-scale direct connect air facility in the world and is used for testing ducted rockets and ramjets. Completed in 1995, it utilizes state of the art computer control to deliver a wide range of air flow rates and temperatures during a single test run, in effect 'flying' a mission while on the test stand.

Signature Characterization Facility (SCF) - This facility is used to characterize the exhaust plumes of rocket motors. The facility consists of a static test stand mounted inside an environmental chamber. Small test motors can be fired under any atmospheric condition of temperature and humidity, and evaluated as to their exhaust characteristics. These include visible and infrared flash, visible and infrared smoke attenuation, toxicity, particle analysis, and mm wave radar absorption.

Russell Measurement Facility (RMF) - The Russell Measurement Facility is a unique elevated laboratory facility located on the south end of Redstone Arsenal, which provides the capability to accomplish measurements, testing, and experimentation on developmental sensor/seeker systems under real world conditions against military targets. The key element of this facility is the 329 foot tower with a high tech laboratory at the 300 foot level that provides a 180 degree view to the west-northwest. In addition, the main elevator also serves as a movable laboratory area where measurements and tests can be conducted at any level from 0 to 300 feet. This elevator provides a 90 degree view toward the east-southeast. The facility is well suited to support a number of activities involved in the development of systems that incorporate optical and RF sensors such as missile systems, fire control systems, target acquisition systems, etc. The facility is available for use by any government agency and their contractors.

Mini-UAV Development Laboratory - This unique facility provides the means to develop, fabricate and test small (60-150 centimeter wingspan) UAVs. It consists of hi-bay space within Building 5400 plus a mobile test van containing equipment for conducting flight tests on Redstone Arsenal ranges. Instruments include dynamometers and thrust sensors for testing small engines equipped with a variety of propellers and gearboxes as well as electronics for testing small servos, miniature sensors, and RF data links.

Advanced Simulation Center - This center, unequalled in the free world, provides hardware-in-the-loop-simulation capability for missiles and submunitions throughout their lifecycles. Consisting of 12 hardware-in-the-loop simulation facilities, the Center provides unique capabilities for closed guidance loop system performance evaluation in a laboratory environment of missiles and submunitions guided and/or fuzed by: microwave and millimeterwave radar; scanning and staring infrared sensors; other electro-optical signals; and by inertially sensed motion. Its international reputation is demonstrated by previous and on-going international programs and consultations with the representatives of Australia, Belgium, France, Germany, Israel, Japan, Korea, and the United Kingdom.

EQUIPMENT/FACILITIES

The AMCOM Distributed Simulation (DS) Center - This facility provides the central node at AMCOM for distributed simulation. This facility contains ten interconnected application rooms for the development and operation of virtual prototype simulators, multiple local area networks, and supporting hardware and software essential to the conduct of DS exercises. It houses the node, or gateway, to the Defense Simulation Internet which facilitates simultaneous distributed experiments at multiple facilities throughout the U.S. and an extensive WAN, which includes HWIL simulations, weapons system hardware, and virtual prototypes of systems and facilitates simultaneous distributed experiments at multiple facilities throughout the AMCOM.

The Advanced Protyping, Engineering and Experimentation (APEX) Laboratory - This facility is a research and development facility whose mission is to address the existing gap between warfighter simulation and engineering level simulation capabilities through the application of Distributed Interactive Simulation (DIS) and the emerging DoD High Level Architecture (HLA) technologies. It provides the infrastructure necessary to link live, virtual and constructive elements in common synthetic environments. This involves integrating the dynamics of doctrine, tactics, mobility, logistic support, Command, Control, and Communications (C3) decision-making, and human reaction in a synthetic battlefield driven by both tactical and technical constraints. The APEX Lab provides a full spectrum systems engineering approach for evaluating emerging systems and concepts in a virtual prototyping environment.

Anechoic RF Test Chamber - This facility is world renowned for its wide anechoic bandwidth and physical size. A specially designed floor provides realistic simulation of surface wave propagation - a unique capability.

Fire Support System Integration Lab - Designed for end-to-end weapon system hardware check out, this facility contains distributed, netted communication nodes which can perform high and low level system tests. The facility is currently uniquely configured to check out the MLRS family of munitions.

UAV System Integration Laboratory - A world class facility unique in its ability to integrate multiple UAV systems and test common subsystem integration interfaces.

Weapon System Interoperability Test Facility - Designed for weapon system software and communication testing, this is the only facility in the U.S. Government having, in residence, Army deployed tactical air defense systems, Unmanned Aerial Vehicle C3 assets, and other ground and fire support weapon and C3 systems. It is regularly used for joint interoperability certification testing, AWE and field demonstration preparation, and soldier training.

Composites Manufacturing Facility - Wholly Government-owned and operated, the Composites Manufacturing Facility provides MRDEC engineers with a "hands on" capability in missile composites manufacturing from project concept, through fabrication, and testing. This facility is the Government's principal repository of technical expertise in this area.

Automated Manufacturing Cells - Contains a uniquely automated, fiberoptic winding capability and a cell for automated inspection of printed circuit boards down to 1-2 mils line width.

EQUIPMENT/FACILITIES

Laser Induced Chemistry Facility - Unique facility which includes lasers covering ultraviolet to infrared and analytical instrumentation to identify compounds resulting from laser induced reactions.

Laser Range - The Physical Sciences Building was designed for high-energy laser operation. A laser range was built behind the building which allows the operation and use of the range from inside the building either by the hi-bay or directly from the lab. The range is approximately 1720 ft long with four islands each with a large mirror mount and electricity. A concrete bridge designed to support a M1 tank connects the islands with the hi-bay area. Chain link fence and interlocks on the interior doors restrict access to the range. Warning lights are positioned down the centerline of the range and on the access doors and gates.

Automated Laser Seeker Performance Evaluation System (ALSPES) - This $2M, one-of-a-kind facility provides complete open-loop test capability for semi-active laser (SAL) seekers/sensors operating at 1.064 microns. ALSPES provides characterizations on prototype/R&D hardware including specification compliance requirements, functional performance, and active electro-optical countermeasures (EOCM) susceptibility, and it has taken a commanding lead in EOCM susceptibility analysis. The facility has been used to test/characterize both foreign and domestic hardware, such as Copperhead, HELLFIRE, HELLFIRE II, Krasnopol, Vehicle defensive-aid suites, and 2.75" laser guided rockets. The modular equipment/software interface allows numerous systems to be tested with minimal changeover downtime.

The Laser Guidance Analysis Facility - This facility, which provides for real time, closed-loop evaluation of semi-active laser guidance hardware, has and continues to be instrumental in the development and life cycle support of such systems as HELLFIRE and Copperhead. It is currently being utilized in the development and demonstration of new laser guidance concepts for the LCPK 2.75 Inch Guided Rocket program.

The Longbow/HELLFIRE and STINGER Systems Integration Facility - This facility is used to evaluate the interfaces and integration of the aircraft platforms, launchers, laser and Longbow HELLFIRE missiles, and STINGER missile. It provides the capability to assess hardware and software designs for entire weapon systems and supporting equipment such as test sets and training missiles.

Actuation Systems Test Facility - This facility provides the capability for testing pneumatic, hydraulic, electro-mechanical, and cold gas jet reaction control systems. It contains equipment for hydrostatic testing pressure vessels to 40 kpsi and pressurizing pressure vessels to 15 kpsi. The facility contains a six-component test stand with instrumentation for testing the forces and moments generated by a cold gas jet reaction system.

Guidance and Control Analysis Facility - An all digital facility for check-out of flight systems, this capability is unprecedented in its system bandwidth. It is currently being used for real-time checkout of high bandwidth CKEM and LCPK guidance and control components.

Inertial Guidance Management and Technology Center - The Center was established by the Army and funded in FY65 to provide central Army monitorship of all R&D in inertial system/components navigation for missiles, aircraft and drones, land navigation; and other applications such as inertial land surveying and inertial fuzing. Full Inertial Test facilities and instrumentation to carry out that function is available.

EQUIPMENT/FACILITIES

Global Positioning System (GPS) Test Facility - The GPS Test Facility has the capability to provide inexpensive GPS hardware testing in a dynamic environment through the use of the two GPS Satellite Simulators (Tester) - GPST. The GPST is used to determine overall system performance including total system navigation accuracy, initial acquisition time-to-first-fix (TTF), geometrical effects (GDOP) satellite management, effects of vehicle dynamics, selective availability/anti-spoofing (SA/A-S) operation, inertial navigation system (INS) aided and unaided performance, antenna gain pattern modeling, jamming susceptibility, and space and control segment errors.

Control Actuation System (CAS) - MRDEC spun off in-house development of a Control Actuation System (CAS) to the prime contractor of the guided MLRS EMD program (Lockheed Martin Vought Systems). Successful development and demonstration of a CAS by MRDEC during the Guided MLRS ATD program has reduced the risk and cost of the GMLRS EMD program. Development and demonstration of a CAS significantly reduced risk areas such as thermal environment, aerodynamic loads, and canard flutter. Cost information gained from development of the ATD CAS was used to negotiate a realistic price with the prime contractor. MRDEC spun off in-house design of a three-axis Control Actuation System (CAS) for the STINGER Block II program. In support of the Low Cost Precision Kill ATD program MRDEC designed a three-axis CAS that meets the package and performance requirements of Stinger Block II.

Air Defense Radar Facility - This facility consists of laboratories, experimental test equipment, including a state-of-the-art test bed radar and test ranges. This facility is now being used to support PATRIOT and SENTINEL product improvement programs, the MEADS development program, and air defense technology projects.

Compact Range Facilities - This facility provides the capability of precisely measuring amplitude and phase transmission characteristics of MMW antennas, radomes, and other devices. These compact ranges have been utilized to characterize threat radar antennas, BAT-P3I Seeker antennas, and multi-spectral materials. Most recently, one of these Compact Ranges has been extensively utilized in the support of PATRIOT's PAC-3 Seeker development.

Army Air and Missile Defense Network Design Facility (AAMDNDF) - This facility provides JTIDS network designs and platform initialization load files for all Joint and Army-only tests, exercises, operations, and contingency events in which Army JTIDS-equipment units participate. The AAMDNDF is the Army's only JTIDS network design facility. Additionally, the NDF supports Army platform specific communications subsystem design, analysis, and testing for intra-Army, Joint, and Allied interoperability on this Joint mandated link. While routinely providing on-call technical support, the NDF is frequently called on to provide on-location support for tactical units deployed to field locations for exercises and contingency missions.

Computer/Software Development (Debug and Modeling) Environment - This one-of-a-kind environment provides full visibility into the operation of code on embedded systems operating with many microprocessors. This environment is microprocessor and microprocessor mount (processor in a socket or permanently attached) independent. This environment allows full visibility into the firmware's operation by stopping the code via breakpoints; display and/or alter the CPU's and code's resources (data structures, registers and the like); and trace the code flow in real-time. Using the modeling capabilities within the environment, analysis based on the actual timing and data flow is used to construct a software

EQUIPMENT/FACILITIES

architecture (repartitioned across the multiple processors). This integrated environment is based on a modular hardware/software architecture and can be easily reconfigured to interface with numerous systems with minimal downtime.

Applied Imagery Lab (AIL) - The AIL is a center-of-excellence for integrating COTS imagery into tactical applications, particularly trainers and system-in-the-loop simulators for weapon systems. Lab focuses on providing low-cost, supportable, high-end PC-based technologies to solve real-time simulation problems. The AIL leverages these PC products with in-house expertise to provide prototyping, development, integration, demo, and test capabilities for tactical system-compatible products requiring real-time operator interactions with visible targets in a virtual environment. Actual tactical system sensors are simulated with these virtual views to provide a realistic operational environment viewpoint to the weapon system operator. Facility is used by a number of program management offices and user organizations to reduce program risk, improve product quality of system trainers, and improve integration capabilities.

Life Cycle Software Engineering Center (Annex) - In August 2000, construction was completed on the 182,300 square foot annex facility (Building 6263) that will expand the Software Engineering Directorate's Engineering Capability to better support Aviation and Missile Systems. This facility will provide a unique platform to enhance the SED mission of performing Software Engineering Support, Interoperability Engineering, Weapon Systems Software Development/Sustainment and software Verification/Validation. The facility will consist of laboratories, a high bay, and engineering workspace. In conjunction with the existing Building 6260, the combination of these two facilities will comprise a complex of some 294,00 square feet, 30 laboratories, adjoining high bays for tactical equipment access, and provide engineering workspace for approximately 900 personnel.

Microfabrication Laboratory - Includes approximately 1,700 sq. ft. of specialized cleanroom space up to class 100, plus an additional 1500 sq. ft. of cleanroom space housing associated equipment. This area is divided into three separate laboratory areas. The first complex contains mask-making and photolithographic equipment. Included is a pattern generator plus a step and repeat camera capable of 0.8 micron resolution. Mask aligners and spinners including one with capability for double-sided patterns used in micromachining technologies (i.e., MEMS) is located here. Specialized equipment of layering EO polymer materials is included. Also, housed in this complex are precision surface analysis instruments such as surface profilers and an atomic force microscope.

Kiowa Warrior (OH-58D) Scout Helicopter Cockpit Procedures Trainer with Image Generator (CPT-IG) Software Support Environment (SSE) - The CPT-IG SSE will provide the AMRDEC Software Engineering Directorate (SED) with the capability to maintain, support and upgrade CPT-IG Trainer software. The trainers are used at the Army Flight School, Ft. Rucker, AL to assist in the training of pilots, co-pilots and maintenance test personnel in operational/maintenance procedures of the actual aircraft. The lab is also expanding to include a Software Support Environment to perform Post Production Software Support (PPSS) for the Kiowa Warrior's Crew Station Mission Equipment Trainers (CSMET).

Robotics Lab - This facility is used for design, development, test and integration of robotic systems. The lab is used in the integration of technology from various sources including other Government facilities and commercial products. The lab is used to expose the user community to robotics and to test new concepts of use.

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Software Engineering Directorate Configuration and Data Management Repository - The repository was established to maintain all the technical software documentation for systems that the SED has software maintenance responsibility. The repository also contains the computer systems and tools used for the daily automated configuration and data management activities that are involved with making software changes to controlled baselines.

Task Force Exerciser - The Task Force Exerciser (TFX) is an Army Air and Missile Defense (AAMD) real-time hardware-in-the-loop interoperability test bed. The TFX utilizes tactical hardware, software, communication devices, and realistic virtual threats to assess AAMD systems ability to support a single integrated air picture, provide and use external sensor support, and to provide supporting information to other joint TAMD mission areas. The TFX provides an environment for AAMD systems to evaluate tactical software prior to field tests, live exercises, or formal tests.

Javelin Simulation Laboratory - A world class digital simulation capability for design, analysis, and evaluation of the Javelin weapon system. Included in this facility is the Javelin Integrated Flight Simulation which integrates a six-degree-of-freedom simulation with tactical missile code and high fidelity modeling of real world environments. In addition, the laboratory is the focal point of the Javelin Integrated Test and Simulation Network that links three other Javelin technology areas within the AMRDEC, the Redstone Technical Test Center, and to the prime contractor facility via the Defense Research and Engineering Network.

Crew Station Research and Development Facility - Three blue/red team stations; fiberoptic helmets; one or two seat standard cockpit; Mission Equipment Simulation Evaluation Facility (MESEF) Cockpit; technical center can simulate 11 other aircraft, 99 threats, 20 moving targets, and C3.

Flying Laboratory for Integrated T&E (FLITE) - modified AH-1S aircraft; Apache PNVS; reconfigurable voice I/O system; flight symbology; fully integrated instrumentation.

NASA-Ames Vertical Motion Simulator - Four interchangeable cabins with virtual TV display; six DOF motion, acceleration, and velocities; sound generation system; pilot and co-pilot positions.

NASA-Ames Helicopter Human Factors Research Facility - Four part-task simulators to investigate; geographic orientation, visual cues simulator, voice actuated controls, and pilot decision-making.

NASA-Langley 14x22 Wind Tunnel - VSTOL/200 knots/variable test section; flow visualization and diagnostics; acoustics capability.

NASA-Ames 40x80x120 Wind Tunnel - NASA-Ames 7x10 Wind Tunnel; NASA-Ames Automation Sciences Research Facility; NASA-Ames Numerical Aerodynamics Simulator; NASA-Ames Fluid Mechanics Laboratory; NASA-Ames Hover Anechoic Chamber.

AATD's Countermeasure Test Facility - Provides the necessary facility support equipment to operate turboshaft aircraft engines throughout their entire operating spectrum up to and including extended operation at full power in a simulated aircraft environment for measurement of acoustic and/or IR radiation and signature testing. Our CTF Facilities include an engine buildup/fabrication shop and engine test stand with both indoor and outdoor run-up capability. Our software allows for 96 pressure

EQUIPMENT/FACILITIES

channels and 105 temperature channels of test data acquisition for user analysis. Our mobile, trailer mounted, Aircraft Infrared Measurement System (AIMS) is field deployable and is used to take full-spectrum IR measurements both at our CTF and Felker Army Airfield here at Fort Eustis, or at other Government or contractor locations. IR measurements taken can be used in survivability analysis as well as design and simulation of prototype IR suppressors. This facility has been used extensively in the past for running the following turboshaft engines, T-53, T-55, T-700, and the 250-C30R. Most recent IR signature testing has been with the T-701C prototype advanced suppressors along with corresponding baseline testing for comparative analysis. Currently, this facility is running the Allison 250-C30R engine to collect relative data for the Armed OH-58D Kiowa Warrior COSSI Program. Acoustical measurements can also be taken for aircraft signature level analysis.

AATD's Instrumentation Facility - Provides instrumentation support for flight tests of prototype weapons systems using a vast array of airborne sensors, transducers, signal conditioning and encoding devices, solid state recorders, telemetry transmitters, telemetry receivers, and decoders. A mobile instrumentation van is maintained to collect, process, and analyze real-time data at test locations both on-site at Fort Eustis or at live-fire test ranges. An additional function is to install integrated prototype avionics and electronics systems on test aircraft for operational suitability and functional evaluation such as PRISM and Phototelesis. Many of these instrumentation projects require on-the-fly design changes of the electrical systems as the work is being performed. The electrical design and redesign work includes designing and building various instrumentation interfaces and signal conditioning circuits for prototype or existing weapons system electronics. Many of our instrumentation projects include onboard video recording of cockpit instruments, test hardware, or the pilot's field of view. We also have capabilities to take still digital photos to document test setups and configuration as well as onboard high-speed video. We can also take still and high-speed film photography to capture events during ballistic and other types of destructive tests. Technicians from the instrumentation area also provide support for the Ballistic and Counter Measures Test areas at AATD to make modifications and upgrades to test cells, equipment, and software. They also provide instrumentation setup and data collection during operational testing in these functional areas. We have our own calibration/validation area within the instrumentation section that tracks all calibrated tools and equipment for AATD. Our accelerometer, pressure, and temperature calibration equipment allows us to calibrate our instrumentation transducers on-site, providing quick response for our test requirements. Additionally, our instrumentation personnel support several other mission areas for AATD including electronic circuit design, computer programming, and computer network maintenance.

AATD's Structural Test Facility - Provides a wide variety of testing equipment, fixtures and facilities to perform both unique aviation component testing as well as common types of materials testing capabilities. This facility includes a rotor blade mid-span fatigue test fixture and a rotor blade root-end test fixture for full scale aircraft rotor blade testing. A torsion fatigue test machine, with loads up to 200 kip, and several axial fatigue load frames ranging form 1 to 200 kip are available. There are two static load frames, one is a precision screw type Instron machine and the other is a hydraulic 300kip Tinus-Olsen machine. Large test articles up to the size of a full scale UH-60 Blackhawk helicopter can be accommodated in our high-bay backstop test area. Vibration testing is also available with hydraulic and electro-magnetic shakers for shake-testing both large and small components. An impact machine is available for high g-force loading. Additionally, we have a large, 4'x4' environmental chamber for specimen conditioning as well as two small chambers adaptable to our load frames. Currently, a commercial S-61 composite main rotor blade is being tested for FAA certification under a Cooperative Research and Development Agreement (CRADA) with Carson Services, Inc. Flight Certification

EQUIPMENT/FACILITIES

Testing of various flight-critical aircraft components has also been accomplished using this facility as well as coupon and panel tests of a wide variety of different sample composite materials.

AATD's Ballistic Test Facility - This facility includes two outdoor ballistic test ranges and one indoor test range. These ranges have instrumented data acquisition and analysis capability. An EPA-approved fuel recovery system is incorporated in one of the outdoor ranges for use in testing aircraft fuel tanks. The facility is capable of test specimens up to full-scale aircraft against API and HEI threats up to 30mm in both foreign and domestic ammunition.

AATD's Experimental Fabrication Facility - Provides aviation fabrication support to special operations aircraft residing at Fort Eustis and other bases in the United States. Support is also provided to AATD for in-house testing and prototype fabrication of Army aviation initiatives. The capability exists to produce almost any machined part that would be found in use on a current Army aircraft. The machinist routinely produced parts with tolerances of less that 1 thousandths of an inch in any configuration.

AATD's Design and Analysis Facility - Provides Engineering Technicians with Computer-Aided Design (CAD) tools for the design and documentation of aircraft components, subsystems and installations in support of AATD mission programs. Although Pro/Engineer is the primary CAD tool for in-house projects, Anvil 1000, CADKEY 97, AutoCAD 13 are maintained to permit interactions with other installations, customers and manufacturers. Individual parts can be designed, assembled and viewed in 3-dimensions with full color, shaded representation. AATD has sheet metal and wiring modules that facilitate aircraft systems design. Engineers in our Engineering Design and Analysis Branch use structural analysis codes such as NISA II and Pro/Mechanica to conduct engineering analyses. All aircraft designs that will be flown are analyzed for flight safety including in-flight and crash loads. Much of this analysis is performed using these codes. Both codes have extensive capabilities to predict structural stresses and deflections and can work from geometry and structural property data generated by the Pro/Engineer CAD software. In addition, Pro/Mechanica has the capability to optimize design parameters for given design objectives such as minimum weight or acceptable stress, or any combination of pass/fail criteria. NISA II is a more generic FEM code, that can handle a wider range of problems including non-linear and composite static analysis as well as eigen value problems such as natural frequency and buckling. Visual information specialists in the Branch prepare presentation and display materials that represent AATD and AMCOM at technical meetings, trade shows, and symposiums all around the world. Their primary tools are Adobe Illustrator, Pagemaker, and Photo Shop. They have the capability of using a wide variety of media ranging from page-sized transparencies to three-foot wide, very long posters or banners.

AATD's Vehicle Antenna Measurement Facility - The VAMF is used to conduct radio-frequency (RF) characterization of communication, navigation, and ASE/ECM antennas and sensors located on large vehicles, including skid and 3-point and 4-point wheel-based aircraft. Since antenna performance can vary significantly depending upon the frequency, function and location on the vehicle, complete spatial RF measurements are required for each integrated system in order to verify and/or optimize the performance. Antenna performance is typically determined by an automated closed-loop RF measurement system, however, the facility is also capable of full-power RF communication system testing and can be easily modified for in-flight range measurements. The Vehicle Antenna Measurement Facility is capable of automated antenna gain pattern measurement and has an adjustable vehicle rotation system, capable of 360 degree azimuthal rotation to conduct RF pattern measurement of antennas and

EQUIPMENT/FACILITIES

sensors located on vehicles up to 40,000 lbs. gross weight and 36 foot wheel base. The facility consists of a dedicated concrete test pad, pneumatic vehicle rotation system, precision RF equipment capable of measurement from 2-6000 MHz, calibrated reference antennas, automated data acquisition and control system, high-speed fiber-optic data link, and auxiliary support equipment. A mobile test trailer allows optimum placement of reference antennas for each specific test, up to 1000 feet from the test pad, and remote control of vehicle position and data measurement via a portable data link.

AATD's Aviation Flight Support Facility - This facility consists of a 75' x 200' hanger with two adjacent helicopter pads located at Felker Army Airfield on Fort Eustis a short ways from both our Main Office Complex and our Research Support Area Complex. With a staff of Government and contractor personnel, we provide aircraft maintenance and training for the Army's AH-64, AH-1, UH-60A/L, OH-58D, UH-1 helicopters as well as the C-12 fixed-wing aircraft. Hanger facilities include 28 V DC and 400Hz, 115 V AC electrical power, ground support equipment, tools, parts, shop stock and all facilities needed for Unit Level maintenance on these aircraft. The Aviation Flight Support, Flight Projects Office of the Prototype Integration Branch, Rapid Prototype Division provides flight test planning as well as coordinating Airworthiness Substantiation Documentation to support the Airworthiness Release Document for related flight test projects.

AATD's Small Unmanned Aerial Vehicle Facility - Research and development of manned/unmanned system technology is provided by this facility which contains sufficient space to assemble and maintain an EXDRONE UAV. The facility also contains avionics and ground support components for the EXDRONE plus components for smaller radio controlled model airplanes. The extended area of the facility contains an operational EXDRONE trailer mounted launcher and space for approximately fifty additional EXDRONE engines.

Army Missile Optical Range - A one-of-a-kind, very large aperture (2m) compact laser range capable of illuminating large targets, under simulated far field conditions, at short range. This facility is used extensively for measurement of Strategic Defense Targets.

EPLRS Emulator Testbed Facility - This facility provides an environment to perform integration testing and network performance assessments without dealing with the frequency management, security, logistics, and safety issues associated with maintaining an Enhanced Position Location Radio System (EPLRS) radio network. An EPLRS radio network can be simulated to provide early test capabilities of the tactical communications network. Testing of the physical EPLRS radio interface may be conducted to provide early indications of physical interface issues. A large high bay area with direct access to the lab testbed allows for weapon system hardware in-the-loop testing for evaluation of the communications systems interface and performance. Simulated multi-node EPLRS radio network with flexible input structures allowing for various combinations of needline layouts and network architectures are accommodated in this laboratory environment of the testbed.

Weapons Tactical Communications Systems Integration Facility - This facility is used for development and testing of tactical command and control system networks and weapon systems communicating on these networks. A unique test tool was developed that acts as a surrogate for elements communicating on a network, providing a mechanism for populating and monitoring tactical communications on the network. The tool provides a scripting capability that allows the user to schedule the transmission of recorded messages using a script or scenario file. The tool has been tailored for the Variable Message Format (VMF) and Joint Variable Message Format (JVMF). Testing can be

EQUIPMENT/FACILITIES
performed to verify the contents of the messages have not been corrupted during transmission and/or to determine cause and effect whenever a corrupted or incorrect message is transmitted/received. Messages can be sent/received that have test information encoded into the tactical header that provides the user with data to analyze system and network performance. This facility includes a sufficient quantity of portable, adaptable processor platforms.

Aviation and Missile RDEC
Redstone Arsenal, AL 35898-5000
(256) 876-3322

Director: Dr. William C. McCorkle
Deputy Director: Herbert M. Carr, COL, AD

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	3.272	N/A	N/A	3.272
6.1 Other	1.473	0.078	2.248	3.799
6.2	23.131	1.217	78.286	102.634
6.3	13.146	3.218	113.247	129.611
Subtotal (S&T)	**41.022**	**4.513**	**193.781**	**239.316**
6.4	12.779	3.278	39.072	55.129
6.5	8.084	4.795	68.401	81.280
6.6	7.285	1.762	26.943	35.990
6.7	8.283	8.658	38.342	55.283
Non-DOD	0.764	0.000	4.730	5.494
TOTAL RDT&E	**78.217**	**23.006**	**371.269**	**472.492**
Procurement	49.348	N/A	42.944	92.292
Operations & Maintenance	39.207	N/A	65.548	104.755
Other	9.771	N/A	12.553	22.324
TOTAL FUNDING	**176.543**	**23.006**	**492.314**	**691.863**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	**SCIENTISTS & ENGINEERS**		**TECHNICAL SUPPORT & OTHER PERSONNEL**	**END STRENGTH**
	DOCTORATES	**OTHER**		
MILITARY	0	0	11	11
CIVILIAN	60	1371	565	1996
TOTAL	**60**	**1371**	**576**	**2007**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1093.216	**REAL PROPERTY**	237.857
ADMIN	358.926	* NEW CAPITAL EQUIPMENT	0.000
OTHER	251.113	**EQUIPMENT**	384.088
TOTAL	**1703.255**	* NEW SCIENTIFIC & ENG. EQUIP.	1.994
ACRES	**4005**	* Subset of previous category.	

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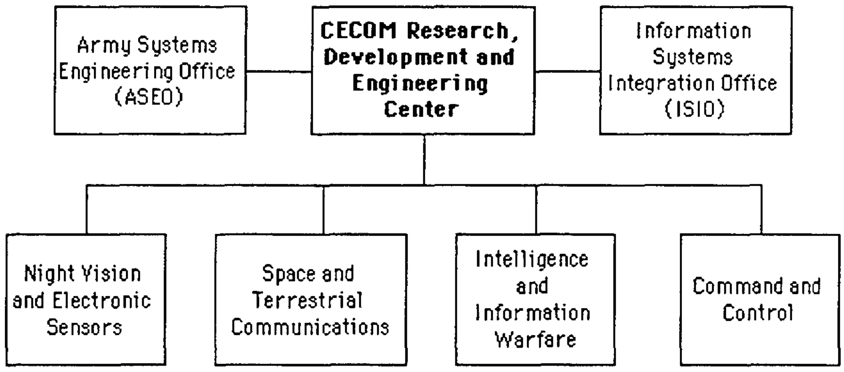
CECOM RDEC

FY2000 Abbreviated Functional Chart - Technical Organizations



CECOM RDEC
Ft. Monmouth, NJ 07703-5209
(732) 427-2686

Director: Dr. Louis C. Marquet
Associate Technical Director: Anthony Lisuzzo

MISSION

To provide America's Warfighter with superior information technologies and integrated systems enabling battlespace dominance by identifying, developing, evaluating and tailoring emerging information technologies; by facilitating the transition of selected technologies into operational systems; and by performing and promoting System of Systems integration.

Vision: To be the universally recognized leader in providing information dominance capabilities to America's warfighters, "...so overwhelming that decisive victory is achieved."

CURRENT IMPORTANT PROGRAMS

Information Systems Integration Office

Enroute Mission Planning and Rehearsal System (EMPRS). First time demonstration of enroute mission planning capability. Enabled commanders and their staffs at all levels (from Joint Task Force down) to understand the evolving ground situation; Coordinate the impact of the mission change received as a result of new intelligence; Request new or updated information from joint ground support elements; Consider available alternative courses of action; and derive and distribute a new mission plan while enroute to the objective.

Night Vision and Electronic Sensors Directorate (NVESD)

Multi-Function Staring Sensor Suite (MFS3) ATD. Develop a compact, affordable sensor suite for long range target identification, mortar/sniper fire location, and air defense targeting using sensor fusion, staring dual band infrared arrays, eyesafe laser rangefinder, multi-spectral aided target recognition (ATR) algorithms, and acoustic arrays.

Lightweight Airborne Multi-Spectral Minefield Detection. Develop stand-off mine detection capability for tactical UAVs using 3-5 um staring Focal Plane Arrays, multi/hyperspectral, passive polarization, passive millimeter wave, foliage penetration radar, synthetic aperture radar, active sources, sensor fusion and electronic stabilization technologies.

Warrior Extended Battlespace Sensors (WEBS). Develop an integrated sensors network to enhance warfighter cognitive performance. The micro-miniature sensors (acoustic, seismic, infrared, magnetic, and RF) provide equivalent capabilities to PEWD II and I-REMBASS.

Space and Terrestrial Communications Directorate

Multifunctional On-the-Move Secure, Adaptive, Integrated Communications (MOSAIC) ATD. The MOSAIC ATD will enable On-the-Move Maneuver Net communications for the Objective Force

CURRENT IMPORTANT PROGRAMS

and FCS. It will develop and demonstrate the core self-organizing, Ad Hoc, mobile network capability. It will use an open architecture approach via application program interfaces to enable integration of other capabilities and technologies including commercial. MOSAIC has three major focus areas:

1. Bandwidth (B/W) Management
2. Adaptive Network Protocols to support Infrastructure Mobility
3. Enhanced Communications Capability through the Integration of Commercial and Department of Defense (DoD) leveraged technologies.

Applied Communications & Information Networking (ACIN) will provide an interface between military operators and private sector technologists, and will adapt and integrate commercial off-the-shelf components to serve military needs. Additionally, ACIN will train and educate decision makers, acquisition officers, and system operators in the proficient application of information technology to 21st century warfare. The ACIN program will be managed by the Center for Telecommunications and Information Networking at Drexel University. CECOM/S&TCD will serve as the Executive Agent for the Department of Defense. The $12.5M in FY01 funding appropriated for this program is in Army RDT&E, Command, Control, Communications Systems, Engineering Development. S&TCD is having ongoing discussions with Drexel University and Sarnoff Corporation to refine both technical and educational projects within the ACIN program. S&TCD jump-started this program with FY00 funds in order to demonstrate the Army's commitment and produce early achievement.

Smart Sensor Communications Networks (SSCN) Technology. The objective is to develop communications network solutions for forward-deployed, unmanned, clustered entities such as smart munitions, sensors and robotic systems that will be deployed with the Objective Force on the digitized battlefield of the future. Sensor technology is enabling identification and tracking of enemy movements is critical to survival of a lightweight force, however energy-efficient networked communications capabilities for miniature microsensors do not exist. These solutions will enable adaptive, self-healing, multi-hop communications networks with optimal routing algorithms that are secure and simultaneously exchanges imagery and data traffic among the clustered entities and rearward to all echelons including all those beyond line-of-sight.

Command and Control Directorate (C2D)

The Battlespace Command and Control (BC2) ATD, a four year advanced development program, successfully completed at the end of FY00. The objective was to exploit information technologies that enhance the science of Battlefield Visualization (BV) which is a key element in two phases of battle command: Mission Planning and Rehearsal and Execution Monitoring. BV is the cognitive process whereby the Commander develops a clear understanding of his current state (enemy and environment), envisions a desired end state, and visualizes the sequence of activity that will move his force from its current state to the desired end state. The technologies we developed include Course of Action development and analysis tools, 2D/3D terrain visualization tools, high resolution displays, and human-computer interface technology. Mature products successfully transitioned to PM, ATCCS. Technologies successfully transitioned to Agile Commander and Log C2 ATDs. Battle Planning and Visualization software was used as part of the JCF-AWE, and several FORSCOM units are interested in BPV software.

The High Energy, Cost-Effective Electrochemical Power Sources STO is a joint effort between CECOM RDEC and ARL to develop high energy, cost-effective electrochemical power sources. The

CURRENT IMPORTANT PROGRAMS

objectives to be obtained by this STO are to develop hybrid power systems optimizing rate and energy; develop lighter weight, lower cost primary and rechargeable batteries; and develop universal charging capability for forward field battery charging.

The Logistics Command and Control ATD program will enable the logistics commander to shorten the operation decision cycle and optimize resources. The objective includes transitioning the following products to PM CSSCS: Course of Action (COA) software for CSS, Data exchange, and Automated CSS data input. The program will produce a wide variety of battle planning, agent services and platform data collection tools. The tools are prototyped, refined in user experimentation then either transitioned not only to PM CSSCS, but also to the entire ABCS community.

Intelligence and Information Warfare Directorate (I2W)

Multi Mission Common Modular Unmanned Aerial Vehicle (UAV) Sensor. Multi-mission/common modular sensor suite for UAV applications demonstrate an affordable family of rapidly interchangeable EO/IR multi-spectral and lightweight MTI/SAR payloads for future tactical or short range UAVs.

Integrated Situation Awareness and Targeting ATD. ISAT will demonstrate HTI RF, missile and laser warning upgrades to the AN/ALQ-211, AN/ALQ-212, AN/AVR-2A and AN/VVR-1 to provide precision hostile situation awareness, target acquisition, geo-location, and combat ID assist for active emitters.

Multifunctional Intelligence and Remote Signal Sensor (MIRSS). MIRSS will develop, test and demonstrate a distribted MIRSS network with on-board automated sensors, advanced communications, remote monitoring and control, advanced power management, and intelligence processing. The system shall provide near real-time operational area information to local Special Operation Forces elements to augment the information disseminated from the national-level imagery and signals intelligence systems sent to the SOP operational intelligence systems.

Technology Transfer

The CECOM Small Business Innovative Research (SBIR) program has become the largest among the 18 Army players. CECOM had the most topics published in the DoD Solicitation and received the most awards. Our FY00 program was approximately $17M. Of this amount, CECOM was taxed $5.5M, a gain of $11.6M. One of CECOM's SBIR Phase II projects won the Army's annual Quality Award. Farance, Inc. won for their technology entitled "Student-Centered Learning System."

The CECOM RDEC had 32 active Cooperative Research and Development Agreements (CRDAs) in FY00. The following highlights some of them:

1. Tech transfer of a CRDA with Ceridian Corp. has evolved into the Broadcast Management Center (BMC) at Ft. Monmouth. Ceridian provided Fixed Satellite Service compatible antenna and hardware. RDEC provided equipment and expertise necessary for integration into the Digital Integrated Lab and support the Global Broadcasting Service Phase I JPO as an "Adjunct-Backup" testbed to the Pentagon and successfully supported TF XXI and a wide range of GBS users across the services. The BMC has evolved to become the home of a dynamic new program called Information Dissemination Management-Technical.
2. CRDA with H-Power Company is an effort to develop improvements to a proton exchange

CURRENT IMPORTANT PROGRAMS

membrane fuel cell stack. Improvements made include running cooler and more efficiently; and increased capacity of the stack.

3. Smart Antenna for Reconnaissance with NJ Institute of Technology.
4. Analysis and integration of "Paint the Night" technology into an existing M2A3 cockpit simulator. CRDAs are with United Defense, General Dynamics and Silicon Graphics.
5. CRDA with Rochester Photonics Corp. focuses on improvement of Laser Pattern Generator by writing surface relief structures in photoresist.
6. CRDA with Rockwell Science Center for determination of the suitability of ECR plasmas for fabrication of 2-color HgCdTe device structures.
7. CRDA with Boeing Co. to examine IR and RF countermeasures for present and future aircraft survivability equipment.
8. CRDA with Radsar Group, Inc. to further the development of the Radiometric Synthetic Aperture Radar System for the purpose of determining its effectiveness as an Emitter Mapping Tool and as an Imaging Tool.
9. CRDA with Rutgers University to plan and conduct advanced development, engineerning, analysis and design of battery power sources, related devices and ancillary equipment.
10. CRDA with SY Technology to develop fabrication techniques for HgCdTe arrays for use in military and commercial IRFPA applications.

IR&D Technical Interchange Meetings (TIMs) are an excellent leveraging opportunity for the transfer of technology between government and industry. One CECOM example is the Wideband Network Radio delivered to CECOM in FY00 and immediately used in the test and evaluation of wideband network technology critically needed to meet the demands of the future Army digitized battlefield. The judicious use of IR&D in the WNR development has provided lessons learned which would accelerate the development of the ultimate Joint Tactical Radio System family of radios.

CECOM RDEC is taking maximum advantage of the Dual Use Science and Technology (DUST) Program to exploit the overall industrial base, to leverage industry's willingness to invest in commercially viable technologies and to reap the efficiencies and reduced costs associated with the large scale commercial sector. Examples of CECOM RDEC DUST programs:

- Uncooled IR Technology (UL3 Alpha Camera for Fire Fighting Helmets)
- Enhanced Terrestrial Personal Communications System
- Command and Control Protect/Information Assurance
- Rapid Command and Control Data Visualization and Decision-Making via a Wargaming Technology.

TSA with General Dynamics Land Systems' Amphibious Systems Group. The TSA allows our Night Vision and Electronic Sensors Directorate to be compensated for providing skilled personnel and equipment to collect calibrated imagery, format, database and characterize data.

The CECOM RDEC ORTA serves as the Deputy Northeast Regional Coordinator of the Federated Laboratory Consortium and we also have an ORTA out of our Night Vision Electronic Sensors Directorate.

In FY00, CECOM RDEC had 23 Invention Disclosures and 13 patents issued.

EQUIPMENT/FACILITIES

The CECOM RDEC boasts many U.S. Government-unique and world-unique facilities supporting a broad range of technical areas. A sampling of our state-of-the-art equipment and facilities follows.

The Digital Integrated Laboratory (DIL) is a dynamic world-class distributed integration facility that electronically links distributed CERDEC labs, industry facilities, Battle Labs, field sites, as well as joint and allied activities. The DIL can be rapidly reconfigured to replicate diverse existing and evolving tactical C4I2W battlefield environments for systems engineering, development, integration, and evaluation of the digital battlefield. The DIL played a major role in the testing of systems for TFXXI, the Division AWE, and the Joint Contingency Force AWE. It is expected to play a similar role in the evaluation of interoperability of systems prior to fielding as part of the First Digitized Division, the First Digitized Corps and the continued digitization of the Army leading up to the deployment of the Objective Force.

The **Displays lab** showcases the latest innovation in display technologies to the Military community and industry. The lab functions as a testbed where the cutting edge display technologies are evaluated and integrated with tactical and commercial systems to ensure compatibility and interoperability. The Displays lab is composed of commercially available off the shelf (COTS) and military grade display devices. Several generations of hardware from the Army's Common Hardware Software (CHS) program and commercial workstations are available for the purpose of integrating and evaluating display technologies for compatibility with the current and future generations of hardware and software. Current successes include the tiling of display devices, construction of display servers capable of displaying multi-mega pixel resolution, integration of touch technologies and wireless mouse and keyboard to workstations, integration of keyboard-mouse-video switches and components, and several other MANPRINT technologies.

The Audio/Interactive Speech Technology(A/IST) Laboratory is a world class facility combining general purpose audio signal measurement and analysis with specialized equipment and expertise for the development of state-of-the-art IST, including speech recognition and synthesis. The facility houses a reverberant chamber for Tactical Acoustics Simulation and an anechoic chamber for testing audio transducer technologies. An extensive suite of "Bruel & Kjaer" acoustic measurement/analysis equipment and professional digital/analog recording equipment combined with an extensive library of military vehicle acoustic environment recordings are available for equipment performance evaluations giving significant cost savings over field tests. Our highly capable staff also performs IST application development/integration and core technology conception/development.

Power Sources Battery Test Facility. This facility performs safety, performance, quality and reliability tests on state-of-the-art power sources for the Army. Everything from developmental prototypes to high volume production samples can be tested to include all types of primary and rechargeable batteries, hybrid power sources, fuel cells and thermophotovoltaic devices.

Davison Army Airfield. Army Aviation is a major application area for NVESD's technologies. NVESD is developing both pilotage and target acquisition systems for current and future Army aircraft. To accomplish this mission, NVESD maintains a unique in-house capability to integrate system technology into various Army aircraft and to test those systems in an airborne environment. Test flight operations are conducted at the Davison Army Airfield, Ft. Belvoir, VA. This facility contains the infrastructure specializing in aviation support for integration, development, test, data collections and

EQUIPMENT/FACILITIES

demonstrations of airborne assets. NVESD maintains a number of aircraft to include two DH-6 Twin Otters, one YEH-60B Blackhawk helicopter, and one UH-1 Huey helicopter. Each aircraft is reconfigurable for systems integration and flight testing of airborne system technologies.

The Semiconductor Microfactory has introduced a revolutionary approach to the rapid prototyping of semiconductor materials for future infrared sensors. This processing line depends on vapor phase processes and the use of high vacuum cluster equipment that prevent contamination of the microchips as often occurs on conventional manufacturing lines. The Microfactory occupies 3200 sq. ft and features the ability to carry out all fabrication steps (i.e. epitaxial growth, metallization, etching, and passivation) while maintaining a wafer in the protective environment of a high vacuum system.

The Virtual Prototyping and Simulation Facility is a state-of-the-art facility that can be used for various activities to include simulation and assessment demonstrations, Advanced Warfighting Experiments, providing virtual reality capability, training support, red team/blue team exercises, video teleconferencing. Its main viewing area seats 36 and presentations are projected onto a 24 x 64 ft. screen. Its computer capabilities include high-end Silicon Graphics computers, SGI and Sun workstations as well as PCs. Computer-aided Design (CAD) and analysis software is used to create and test virtual prototypes. Various night vision sensors can be simulated through the Paint the Night software program that includes atmospheric and sensor effects with realistic virtual vehicles and terrain databases.

Night Vision and Electronic Sensors Directorate's (NVESD) outstanding facilities for Fabrication and Integration of prototypes, surrogates and components provides comprehensive in-house manufacturing capability for a range of small high-precision components up to heavy steel and vehicle-based systems. A 56,750 square foot fabrication facility is staffed by mechanical engineers, machinists, sheetmetal mechanics, welders and engineering technicians. The integration facility and staff specializes in small quantity, custom, and surveillance/optical systems and is fully equipped to construct and install prototype and surrogate items for R&D test beds.

Three test facilities are operated at nearby Fort A.P. Hill, VA. The Observation Range is used for ground-to-ground, air-to-air and ground-to-air sensor operations and evaluation. It contains a heliport with two pads and a hanger, a 12-bay observation building overlooking an 800 x 3500 meter long line of sight observation range with 20 surveyed and monument points to provide exact target locations. The Laser Range is a unique and highly instrumented facility allowing users safe testing of non-eyesafe lasers. It contains four bays, an isolation platform and an elevated platform. Targets of interest can be deployed for ground and air testing at six discrete target ranges all with high voltage, high current commercial power. Range 71A is uniquely suited to test mine detection equipment and is specially located to allow high impact explosive demonstrations.

NVESD's clean room will be utilized to fabricate both cooled and uncooled infrared detectors. This facility will house both a class 100 clean room and a "white" room. It will have photolithographic and metalization capabilities to allow detector array patterning, reticulation, and contact metalization of microfactory grown samples. The "white" room will provide packaging and discrete device testing facilities.

The NVESD Mine Lanes Facility at Ft. Belvoir was built to support Countermine testing. Six mine lanes, each 8-feet wide by 6-feet deep by 108-feet long contain five different soil types (sand, gravel,

EQUIPMENT/FACILITIES

clay, loam, and magnetite). Two lanes have the same type soil. The lanes are separated by non-metallic barriers to prevent the mixing of soils between adjacent lanes and prevention of false alarms that metallic barriers would produce. Various buried mine targets can be emplaced in this clutter-controlled environment. The entire shelter is non-metallic to reduce any possible adverse effects on highly sensitive mine detectors. Three ceiling mounted trolleys are in place on which to mount detection systems and sensors. A control room overlooking the lanes is complete with recording and monitoring devices and contains controls to operate the trolleys. The facility has traditionally been used for hand-held mine detector evaluation, primarily electromagnetic induction sensors and more recently to test ground penetrating radar sensors. It is often used for briefings and to give technical demonstrations.

Intelligence and Information (I2) Warfare Center of Excellence houses 10 world Class Laboratories: Anechoic Chamber, Army Cryptologic Operations Support Laboratory, Integrated Intelligence Concepts Laboratory, Joseph O'Connell Simulation Laboratory, Quick Reaction Capability SIGINT Integration Laboratory, Radar Laboratory, Signal Processing Laboratory, Survivability Integration Laboratory, and the TROJAN SPIRIT Enhancements and TROJAN Systems Development Laboratories. The facility has limited access and Sensitive Compartmented Information Facility (SCIF) areas. It has enabled CERDEC to expand our world-class R&D capabilities in the areas of signal intelligence, intelligence collection, intelligence data fusion and electronic countermeasures.

Wideband Communications Mobile Network Environment (WCMNE). This S&TCD laboratory supports the research and development of advanced communications protocols and technologies for tactical mobile users, specifically dismounted, handheld and vehicular. The facility provides the capability to test selected protocols in a laboratory environment, in a simulated mobile environment, as well as in local field environments. It supports the rapid prototype development of a representative operational capability to facilitate a system developers' understanding of quickly evolving networking communications protocols and technologies. Both performance characterizations and requirements validations can be performed within the facility. WCMNE is a sophisticated state-of-the-art facility that includes a reconfigurable eight-node bench top analysis capability to evaluate emerging communications development in mobile wireless networking protocols, architectures and technologies. The bench top capability includes network evaluation tools for example Net-XRay, NetTest, TARDIS NTP Time client/server software, the SEAM-LSS related User Behavior Model (UBM) Traffic Generator and an array of COTS hardware (radios and computers) and software. The environment incorporates the use of the CECOM Wide band Radio Network Testbed (WRNT) to provide for dynamic experiments. A key component of the facility is the ability to coordinate real experiments with virtual experiments. The Simulation and Evaluation of Adaptive Mobile Large Scale Network Systems (SEAM-LSS) modeling and simulation environment provides the capability to emulate large networks and assess scalability and topology. The capability of the environment provides for the evaluation and integration of emerging middleware and applications. The facility also includes a Software Development Environment and an Integrated Signal Processing Environment for system-level design. The environment is flexible and provides for deployment capability to the field for experimentation and demonstration. WCMNE provides for the capability to transition/leverage emerging technologies into current and next generation's military systems. The facility currently supports the DARPA SUO SAS and GloMo programs, JTRS and Wireless LAN.

The WRNT is one of four products of the Wideband Radio Networking (WRN) Program. The testbed is a computer automated wideband radio network emulator, which allows scripted repeatable tactical mobile network scenarios to be exercised in a laboratory environment, eliminating the expense

EQUIPMENT/FACILITIES

and complexity of actual field testing. The present WRNT can perform test and evaluation of up to 8 legacy of future network radios, waveforms, or protocols, with expandability to a network size of up to 100 radios. The system is presently being used in the CECOM WCMNE facility to aid in the test and evaluation of DARPA GloMo Program network and protocols and technology as well as several commercial network radios and communications products. The testbed will be used in the development of advanced wideband (high data rate) network waveforms for future porting to the Joint Tactical Radio System (JTRS) family of radios. The WCMNE facility has also been offered to the JTRS Joint Program Office as a joint testbed for JTRS prototype radio testing and architecture validation. The WRNT is a valuable RDEC asset, and expansion and enhancement of its capabilities is planned in the near future.

The SEAM-LSS area of the WCMNE provides an integrated modeling and simulation environment that supports the evaluation of mobile communications networks. It includes the capability to model realistic military communications environments to include threaded traffic, scenarios, terrain, propagation, metrics and analysis. It provides capability to simulate voice, video, data and multi-media traffic in a heterogeneous network comprised of over 500,000 discrete nodes in a unicast, multi-cast or broadcast mode. It includes features to model Quality of Service and encryption. It can be "parrellized" to improve performance and has the capability to be used remotely over a web-based graphical user interface. The SEAM-LSS environment, once populated with system models can showcase those technologies enabling evaluation of military efficacy.

Infosphere Security Laboratory. The facility is used to evaluate military and commercially available trusted secure network products, and develop secure enhancements and integrate them into a multi-level secure environment for use in Army Tactical Command and Control Systems. The Infosphere Security Laboratory is also used for video system evaluation and integration over communication systems, which enhances the digitization of the battlefield. This laboratory is used to evaluate COTS/GOTS hardware and software products, such as firewalls, guards, intrusion detection software, network scanners, network mapping tools, sniffers and other network security tools. The objective of ongoing efforts is to track new technologies to provide a rapid capability to perform and enhance the security of Army C2 tactical systems and to coexist within the tactical Internet environment.

Terrestrial PCS CDMA Testbed. The Terrestrial PCS lab contains advanced CDMA commercial and prototype infrastructure that allows the CECOM STCD to conduct detailed test and evaluation of the commercial CDMA technology and its application to the tactical environment. The CDMA testbed consists of two fixed commercial Base Transceiver Systems (BTS) and one Base Station Controller (BSC) and Mobile Switching Center (MSC) that allows for in-lab tests and demonstrations of the technology. This is commercial off the shelf equipment. We also have two prototype downsized BTSs and BSC/MSC that provide us a test capability that can be deployed into a tactical testing environment such as the recently concluded Joint Contingency Force exercise. Both the large network and the small network are connected to our conceptual future switching node that allows for testing between new and legacy systems. We also have a large number of commercial handsets and will also be testing and evaluating the new CONDOR secure handsets in the near future. The lab also contains an assortment of commercial test equipment that aid in the evaluation of the CDMA technology.

Communications System Design Center (CSDC). This laboratory is for evaluating and experimenting with fielded voice and data communications systems. The laboratory enables the rapid analysis, prototype integration and testing of Non-Developmental Items (NDI) and Commercial-off-the-Shelf (COTS) products, and is used for evaluating and experimenting with fielded voice and data

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communications systems. Part of the Communications System Design Center (CSDC), the Warfighter Information Networking Lab is used to perform applied research in communications technology with the objective of developing and integrating next-generation communication systems for the Army. Other areas include the MSE Support Facility, the Development Engineering Facility, the System of Systems Central Patching area, an Army Integration Network (AIN) Terminal, the Advanced Network Technology Facility, the Networks Management Facility, and the Classified Data Processing Center. These areas provide support for all circuit and packet network systems, ATM switching and support the in-house design, development and/or product improvements for unique devices.

Satellite Communications (SATCOM) Engineering Laboratories (SEL). The SATCOM Engineering Laboratory (SEL) supports research, development, performance evaluation, system certification testing and anomaly resolution of space-dependent and space-based communications systems and equipment in the UHF, SHF, and EHF frequency bands. The SEL has four functional areas: Strategic Sys Lab, Control Systems Lab, Tactical Sys Lab, and Broadcast Management Center. All of the labs are interconnected with each other as well as to the CECOM Software Engineering Center and other CERDEC Digital Integrated Labs. This allows full connectivity to DISA for AIN, SIPRNET, NIPRNET, JWICS, etc. access and permits joint testing with the other services, battle labs, academia and industry. There are several unique assets in the labs, such as AN/GSC-39 SATCOM Terminals, DSCS III Satellite Simulator, Digital Communication Satellite Subsystem, Standardized Tactical Entry Point, UHF SATCOM Manpack Terminals, 5KHZ and 25KHZ DAMA UHF Satellite Test Emulators, and prototype SATCOM on-the-move antennas.

The Tactical Internet Laboratory in the CECOM Digital Integrated Lab provides test results and recommendations for contractors and program managers to develop network architecture and the communications software for TI. The goal of the CECOM TI Lab is to validate the Tactical Internet capability through laboratory network testing and to sponsor experimentation and technology demonstrations to enhance Tactical Internet technology. The TI Lab can be configured to replicate different portions of the TI architecture for testing and experimentation. Data generators are used to apply prescribed levels of traffic loading and to measure the response of the network. Special network test tools are used to monitor traffic on the net and to measure delay and message completion rate under various conditions.

CECOM RDEC
Ft. Monmouth, NJ 07703-5209
(732) 427-2686

Director: Dr. Louis C. Marquet
Associate Technical Director: Anthony Lisuzzo

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.868	N/A	N/A	0.868
6.1 Other	0.305	0.076	1.132	1.513
6.2	19.456	4.864	75.084	99.404
6.3	31.042	7.760	120.290	159.092
Subtotal (S&T)	**51.671**	**12.700**	**196.506**	**260.877**
6.4	7.215	5.553	10.936	23.704
6.5	4.558	4.327	14.948	23.833
6.6	3.429	0.381	21.027	24.837
6.7	2.966	2.966	28.236	34.168
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**69.839**	**25.927**	**271.653**	**367.419**
Procurement	21.348	N/A	41.346	62.694
Operations & Maintenance	11.658	N/A	37.129	48.787
Other	3.970	N/A	29.377	33.347
TOTAL FUNDING	**106.815**	**25.927**	**379.505**	**512.247**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	2	4	22	28
CIVILIAN	67	1023	527	1617
TOTAL	**69**	**1027**	**549**	**1645**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	535.000	**REAL PROPERTY**	85.000
ADMIN	238.000	* NEW CAPITAL EQUIPMENT	0.800
OTHER	99.000	**EQUIPMENT**	302.200
TOTAL	**872.000**	* NEW SCIENTIFIC & ENG. EQUIP.	3.900
ACRES	**1077**	* Subset of previous category.	

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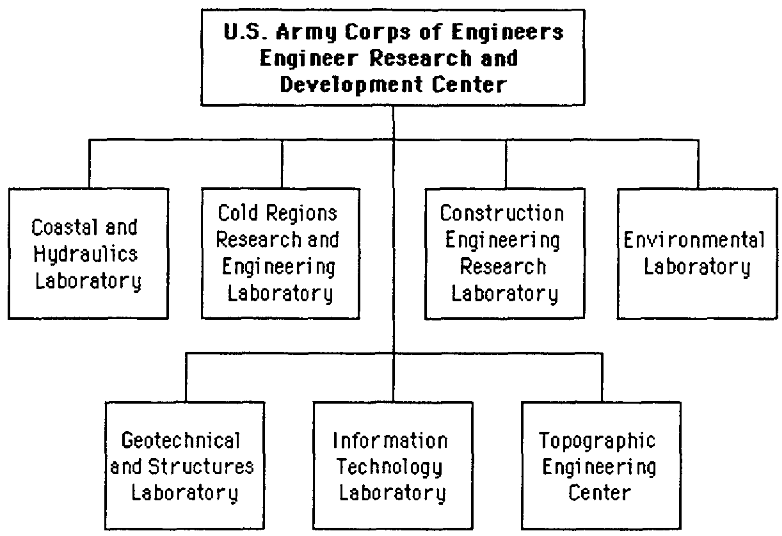
Engineer Research and Development Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Engineer Research and Development Center
Vicksburg, MS 39180-6199
(601) 634-2504

Director: Dr. James R. Houston
Commander: COL James S. Weller

MISSION

The Engineer Research and Development Center (ERDC) is the research and development organization for the U.S. Army Corps of Engineers (USACE). The ERDC supports the total Army engineer effort through its Military Engineering, Environmental Quality, and Civil Works research and development (R&D) programs.

The Military Engineering R&D supports Army system developers, the combat engineer in the theater of operations, and the facilities engineer at Army installations around the world. Research efforts supporting system developers provide the basis for a common relevant operating picture of the battlespace and an understanding of the physical processes of the terrestrial battlespace. Research efforts supporting the combat engineer focus on mobility, countermobility, survivability, sustainment engineering, and topography. Topographical research provides critical operational support to the Army in theater by providing terrain and terrain-related information on the battlefield environment. The installation and environmental quality research programs focus on providing technologies to improve the affordability of Army facilities and lands while ensuring the Army meets its environmental compliance and stewardship responsibilities.

The ERDC Civil Works R&D program, combining its engineering and scientific expertise, focuses on reducing the cost of constructing, operating and maintaining the Nations infrastructure of navigable waterways, harbors, and related recreation areas. The Civil Works research program also addresses a variety of flood control, environmental quality, regulatory and emergency response issues. This research supports the operating Corps of Engineer Districts responsible for execution of the Army's Civil Works program.

CURRENT IMPORTANT PROGRAMS

In FY99 the Corps of Engineers consolidated its eight research laboratories under a single organization called the Engineer Research and Development Center (ERDC). The resulting integration of the research program increases the synergy among research personnel while providing cost efficiencies. The Corps research community will continue to work closely with academia, industry and other Federal agencies in developing and applying innovative technologies.

Under its Military Engineering program the ERDC performs research and development for enhancing engineer capability to deploy rapidly and to sustain a full range of military operations. The major initiatives include those listed below:

- Airfields and Pavements for Force Projection
- Logistics Over the Shore
- Survivability and Protective Structures
- Lines of Communication Assessment and Repair
- Advanced Mobility Modeling
- Maneuver Support Modeling and Simulation
- Rapid Terrain Mapping and Visualization
- Tele-Engineering.

CURRENT IMPORTANT PROGRAMS

Under its Installation Support program the ERDC conducts infrastructure and environmental sustainment research, development, studies and technical assistance to maintain a quality trained and ready Army and to preserve and protect its land, water and natural and cultural resources. Major research initiatives include the following areas:

- Munitions Production Compliance Technologies
- Sustainable Military Land Use and Stewardship of Army Lands
- Training Land Carrying Capacity
- Protocols for Military Training to Reduce Impact on Threatened and Endangered Species
- Facility Seismic Risk Mitigation
- Facility Delivery Process Improvement
- Integrated Installation Management
- Utilities Modernization and Optimization for Military Installations.

The ERDC Civil Works research program focuses on developing and applying technologies for reducing the cost of constructing, operating and maintaining the Nation's Civil Works structures and facilities such as navigable waterways, harbors, and related recreation areas. Major research initiatives include the following areas:

- Ecosystem Management and Restoration
- Innovative Design and Construction
- Earthquake Engineering
- Risk Analysis for Civil Works Projects
- Geospatial Technology.

The ERDC is expanding its use of the Internet as a major delivery mechanism for transferring technology to military and civilian engineers. For example, the Tele-Engineering effort will provide combat engineers with real-time access to experts via satellite and the Internet to help solve complex maneuver and force support engineering challenges in the theater of operations. The Land Management Systems (LMS) will integrate existing land management and environmental analysis systems and provide a common delivery framework for access to these integrated tools by users via the Internet. The ERDC has also initiated a major effort to provide computer-based tools via the Internet to facilitate real-time building design and constructability reviews by government and industry teams.

EQUIPMENT/FACILITIES

ERDC Unique Facilities - The ERDC operates and maintains over $1.2 billion in unique research equipment. This equipment is available for use by public and private organizations working with ERDC personnel through a variety of existing authorities such as Cooperative Research and Development Agreements (CRADAS), Technical Assistance Agreements, and other arrangements. Below are some of the key research equipment and facilities:

Spectral Research Facility - TEC
The Spectral Research Facility contains a Digital Multi-Spectral Video camera, and multiple spectral radiometers and fluorometers used in studying both passive and active phenomena in the visible, near infrared, and thermal electromagnetic regions.

EQUIPMENT/FACILITIES

Survey and Global Positioning System (GPS) Laboratory - TEC
The TEC Survey and GPS research laboratory has eight (8) geodetic-quality GPS receivers, permanent differential GPS reference stations with broadcast capabilities, and conventional survey equipment. This facility is used to develop and test survey techniques and equipment for use in positioning and navigation, and, in conjunction with other systems, for obtaining high-accuracy terrain and navigation channel elevation data.

Terrain Information Extraction System (TIES) - TEC
The TIES provides a capability for extracting up-to-date terrain data from remotely sensed images. The Collection Management Office (CMO) provides TEC the capability to rapidly query status and order national or commercial imagery in hardcopy or softcopy formats.

Integration and Evaluation Center (IEC) - TEC
The IEC complex is a robust facility combining communications and computational capabilities to provide real-time visualization of complex integrated joint service demonstrations and exercises. The facility mixes both actual and simulated activities in a single visual/aural demonstration of an operational or training exercise, accessing data and imagery worldwide. It uses commercial wideband and tactical communications links to provide connectivity with live exercise activity and distributed simulation networks and acts as the central hub of the demonstration network. The Center can also be used to support natural disaster planning and assessment.

Imagery and Geospatial Data Exploitation Testbed (IGDED) - TEC
The IGDED was developed to provide the warfighter with the technologies needed to achieve superior knowledge of the battlefield through more timely collection, exploitation, and dissemination of imagery and geospatial data and products. The IGDED allows TEC to install and integrate new imagery evaluation and examination tools and evaluate imagery and national tasking capabilities.

Eagle Vision II (EVII) - TEC
The Eagle Vision II prototype is a mobile, integrated, commercial satellite imagery receiving and processing system. It allows access to multiple commercial satellite imaging systems from a forward-located position during natural disasters and other crises. The EVII prototype houses systems that directly download imagery from SPOT, Landsat, Radarsat, and EarlyBird commercial satellites while they are in direct line-of-site of the system. Additional satellites are under consideration for addition to the original EVII-accessible constellation.

DoD High Performance Computing Major Shared Resource Center - ITL
This 55,000 square foot facility includes multiple, state-of-the-art High Performance Computing systems which provide the most powerful scientific and engineering capability in DoD with 47000+ Megabytes of memory, 6,700 Gigabytes of high-speed disk, and 500 Terabytes of high-speed robotic archival storage. Includes a $4.1M Scientific Visualization Center to identify and develop innovative methods of interpreting large data sets from modelings/simulation, field data collection, and Computer-Aided Design and Drafting (CADD) applications.

EQUIPMENT/FACILITIES

Mobile Ballistic Research System - GSL
This facility provides the DoD with the capability to conduct projectile penetration field experiments at geologic sites of interest. The truck-mounted, breach-loaded ballistic gun can launch large-scale (up to 155-mm) projectiles at velocities as high as 3280 ft/sec. Associated diagnostic instrumentation and analysis hardware are contained within a support trailer.

Geodynamics Research Facility - GSL
This unique facility within DoD houses a wide variety of high-pressure dynamic devices that simulate explosive loadings under controlled stress states on geologic and man-made construction materials. The characterization of their material behavior is required for weapons effects assessment against military fixed assets.

Projectile Penetration Facility - GSL
Unique to DoD, this facility enables investigation of anti-penetration shielding technology techniques employing geologic and manmade structural materials against a wide variety of threats. An 83-mm diameter gas gun has the capability of launching projectiles with masses up to 6.2 lbs at velocities in excess of 6562 ft/sec and launching projectiles with masses of 26.5 lbs at velocities of 3280 ft/sec.

Mass Construction Materials Laboratory - GSL
A 20,000 square foot concrete research and development laboratory for determining physical, chemical, and mineralogical properties of concrete and other construction materials as well as the structural response of subscale models.

Airfields & Pavements Research Center - GSL
This 25,000 square foot, state-of-the-art facility contains the DoD-unique Joint Sealant Laboratory and an Automated Data Acquisition System for acquiring rheological data on creep, strength, resilient moduli, and fatigue of a variety of paving materials.

Soils Research Center - GSL
The 10,000 square foot soil mechanics research facility is the largest in DoD. It has a loading capability of 250,000-lb on triaxial specimens up to 15 inches in diameter. Also included are direct shear devices for 3 to 24 inch specimens, automated consolidometers and rock-testing capabilities including anchor pullout tests.

Full-Scale Aircraft Loading Facility - GSL
Simulates aircraft loading with different wheel loads and gear geometry applied to full-scale constructed test pavements; response and performance data for development of new design and behavior theories; current fighter and transport aircraft simulators. Can conduct tests of aircraft gears from a single wheel up to 12 wheels to simulate the C-5 or Boeing 747.

Heavy Vehicle Simulator-Aircraft - GSL
The largest portable automated trafficking device in the world capable of replicating multiple or single aircraft or vehicle traffic. This device can apply over 1 million passes on a pavement section in 5 months to provide valuable data for predicting long-term pavement life.

EQUIPMENT/FACILITIES

Mobility Instrumentation Facility - GSL
A 30,000 square foot complex is used for conducting research and development investigations of cross-country mobility, trafficability, and terrain data acquisition. This research requires complex design and fabrication of real-time data collection and analysis hardware unique to quantifying the performance of all types of wheeled, tracked, and amphibious military vehicles. A 14,000 square foot annex is optimally structured to support modeling and simulation in distributive interactive simulations and virtual prototyping in support of battlefield automation.

Geosciences Research, Applications, and Test Facility - GSL
This facility provides the most extensive near-surface geophysics equipment and applications capability in DoD. Specializing in engineering, environmental, archeological, and groundwater geophysics, and geology, the facilities support the DoD requirements for foundation investigations, installation restoration, cultural resource assessments, military groundwater supply, tunnel detection, and environmental site characterization. In addition, a 15,000 square foot Engineering Geophysics Training Facility consisting of metallic and non-metallic targets buried at various depths and orientations, is used for evaluating geophysical instruments and providing hands-on training with the equipment.

Microtunneling Test Facility - GSL
This facility is the largest in the US with six different soil types, horizontal inclinometers, settlement plates, and strain gauges to evaluate microtunneling and directional drilling equipment.

US Army Centrifuge Research Center - GSL
Uniquely large and powerful, the research centrifuge weighs 85 tons and has a 21-ft radius; it can apply a maximum g-force of 1256 g-tons operating at 350g's for a 2.2 ton payload and at 143g's for an 8.8 ton payload (1g = normal gravity). A 27.5-year event can be replicated in one day operating at 350g's. Research applications include all areas of civil and environmental engineering with particular focus on earthquake engineering, coastal engineering, structural engineering, blast phenomena, and groundwater behavior.

TeleEngineering Operations Center - GSL
Unique to DoD, this facility provides the warfighter with solutions to complex, real-world engineering problems using the entire Corps of Engineers knowledge-base capabilities through classified and unclassified computer networks and high performance computing assets. Rapid response problems beyond in-theater expertise will be provided using existing C2 architecture.

Hazardous and Toxic Waste Research Center - EL
The 17,000 square foot HTWRC is the only DoD-permitted (RCRA) facility to conduct large volume HTW research, development, test, and evaluation. EPA recognizes the HTWRC as the Nation's premier facility. An 8,000 square foot addition to this facility was completed in FY99.

Environmental Chemistry Laboratory - EL
A 22,000 square foot analytical chemistry research and testing facility houses state-of-the-art equipment to address DoD research, analytical, and quality assurance requirements for environmental quality, contaminated sediments, and environmental restoration facilities. This laboratory meets the demands for high hazard research (i.e., dioxins and dibensofurans) and at detection levels that meet requirements of health and regulatory risk-based hazardous risk assessments. The Corp's Chemistry Quality Assurance facility, with 20,000 square feet of chemistry laboratories, located in Omaha, NE, was realigned with

EQUIPMENT/FACILITIES

WES in 1998. Together, these chemistry laboratories provide one-stop-services for all environmental design and construction quality assurance during the engineering design and construction or environmental projects within the DoD.

Fate and Effects R&D Center - EL
This 30,000 square foot facility has complete experimental radioisotope, microbiology, toxicity, and instrumentation laboratories for investigations of contaminant fate and effects on ecosystems.

Lewisville Aquatic Ecosystem Research Facility (LAERF) - EL
This nationally recognized unique 110-acre aquatic research facility is located in Lewisville, TX. This facility is the largest complex of aquatic research micro-, meso-, and macrocosms in the world conducting research on ecology of aquatic and wetland vegetation, biocontrol techniques for aquatic vegetation, chemical control of nuisance vegetation, and hydraulic flow-through vegetation.

Eau Galle Aquatic Ecosystem Research Facility (EGAERF) - EL
This 2,000 square foot laboratory facility is located on Eau Galle reservoir near Spring Valley, WI. Research is conducted on phosphorus dynamics, sediment-nutrient interactions and restoration and environmental management of aquatic ecosystems.

Trotter's Shoals Limnological Research Facility (TSLRF) - EL
This facility is located on the Richard B. Russell Reservoir near Calhoun Falls, SC. This facility consists of a 1,400 square foot analytical building, a 2,040-square foot office complex, and numerous large research vessels. This facility provides field and laboratory support for research on limnological processes associated with operation of large flood control and hydropower projects.

Columbia River Basin Research Facility - EL
This facility is located at North Bonneville, WA. This facility consists of approximately 4,400 square feet of offices and several large research vessels. Research conducted at this facility supports large-scale experimental monitoring of fish passage in the region.

Aquatic and Wetlands Ecosystem Research Center - EL
This 10,000 square foot research center provides the capability to evaluate the impact of DoD activities on aquatic and wetland ecosystems, including impacts on threatened and endangered species, and wetland identification, delineation, and evaluation.

Cold Effects Laboratories - CRREL
CRREL has a complex of low temperature laboratories and experimental research facilities not found anywhere else in the world. The main laboratory consists of 24 low temperature research laboratories with a temperature range down to -50 degrees F.

Ice Engineering Facility - CRREL
The 73,000 square foot Ice Engineering Facility houses three special-purpose research areas; a large low-temperature towing tank, a 100-foot long refrigerated flume for modeling rivers, and a large hydraulic-model room for studying ice impacts on civil works facilities, primarily locks and dams. A snow wind tunnel was put in operation in 1996.

a. **Model Ice Towing Basin:** The model basin is a 120-foot-long by 30-foot-wide by 8-foot deep basin located in a refrigerated room with a low temperature capacity of -24°C. The pool

EQUIPMENT/FACILITIES

uses urea doped water to create an ice sheet with a practical range of ice thickness of 2 to 15 cm and ice strength of 20 to 120 kPa for studying the mechanical behavior of ice and ice-structure interactions. The tank is equipped with dedicated instrumentation and data acquisition systems for measurement of ice forces. The facility includes a towing carriage to pull structure models through the ice sheet.

b. **Hydraulic Flume:** The Flume is a recirculating channel that is 120-foot-long by 4-foot-wide by 2-foot-deep located in a refrigerated room with a low temperature capacity of -24°C. It can be tilted from 2 degrees normal slope to 1 degree adverse slope, and has a flow capacity of 0.4 m^3/s. The bottom of the flume can also be refrigerated. The flume can carry sediments. The Flume is used primarily to investigate fundamental ice processes in streams, such as formation, evolution, and accumulation of frazil ice, formation of anchor ice, ice jam initiation and development, sediment transport and bed erosion under ice cover conditions, etc.

c. **Scale Model Hydraulic Facility:** The Hydraulic Facility is a large (80- by 160-foot clear span) refrigerated room where large-scale physical models of sections of rivers and lakes can be built and operated to simulate natural winter conditions and test scale models of remedial measures to ice problems. Models of reaches of rivers can be constructed to test means to alleviate ice jams or investigate navigation in ice. Models of flow control structures can be built to study improved means of ice passage and other ice-structure interaction problems. The Hydraulic Facility can also be used to duplicate frozen soil masses for various purposes, determine the efficiency of various equipment such as thermosyphons, or to cold-test vehicles and other outdoor equipment.

d. **Snow Wind Tunnel:** This new atmospheric wind tunnel was put in operation in 1996. It is 60-foot-long, 8-foot-wide and 4-foot-high. It is an unrefrigerated facility that uses glass beads to model snow. Air flow velocity ranges up to 11 m/s. It is used primarily to study snow transport processes and to model snow drift accumulation around structures and to devise remedial measures. Other studies of environmental processes requiring wind tunnel modeling can be conducted in this facility. It is equipped with an automated traversing mechanism for measurements of air flow velocity distribution and snow drift pattern.

Frost Effects Research Facility (FERF) - CRREL
The 29,000 square foot FERF supports full-scale research on the impact of freeze-thaw cycles on pavements, foundations, and utility systems. The nationally unique FERF facility provides the capability to simulate natural 3-D freeze-thaw cycles to support research on the impact of these cycles on pavements, foundations, and utility systems.

Low Temperature Material Test Facility - CRREL
The unique 9000 square foot Low Temperature Materiel Test Facility provides additional capability to investigate composite materials performance subject to low-temperature and thermal cycling for potential use for future Army armor vehicles. USACRREL also has access to two permafrost research sites in Alaska.

Heavy Vehicle Simulator (HVS) - CRREL
The HVS is a vehicle and aircraft accelerate trafficking machine capable of applying 20 years of equivalent traffic in four to five months. Truck dual tires or a super single tire can apply up to 11,000 passes a day at 8 miles per hour in one or both directions with up to a 25,000 lb load. A C141 aircraft tire can apply up to 45,000 lbs. load at 4 mph in both directions for 11,000 passes a day.

EQUIPMENT/FACILITIES

Remote Sensing/Geographic Information System Center - CRREL

The Remote Sensing/Geographic Information Systems Center is involved in flood mapping, emergency management, water resource management, as well as large-area environmental assessments critical to emergency response efforts. This 16,400 square foot state-of-the-art facility is used to develop technologies that measure and monitor environmental conditions over land and water surfaces and provide RS/GIS data and overlays to a diverse collection of R&D projects.

Geophysical Research Facility (GRF) - CRREL

The GRF serves the needs of the Navy for sensing and understanding the behavior of sea ice. The GRF is an outdoor saline ice pond. It is a 60-foot by 22-foot by 7-foot deep concrete basin with a removable refrigerated roof to maintain the ice cover and protect it from snow. It has refrigeration to allow early season growing of ice sheets, as well as maintaining the character and thickness of ice sheets. The practical limit for ice sheet thickness is about 1.5 feet. A separate basin on one end of the GRF allows mechanical testing of large ice blocks. The GRF is the primary experimental facility for joint Navy and CRREL research on sea ice electromagnetics.

Permafrost Tunnel - CRREL

CRREL has a research permafrost tunnel and maintains a 133-acre permafrost research site at the Alaska campus in Fairbanks. The CRREL facilities in Alaska include two coldrooms capable of -300°F temperatures, a heavy equipment maintenance shop, a woodworking shop, a soils laboratory, a shock laboratory, and several Small Unit Support Vehicles (SUSVs) used as research vehicles.

The High Performance Materials Laboratory (HPML) - CRREL

The HPML is used for strength and thermal testing of many types of materials, including construction, road, bridge, and composite materials. Specialized testing machines, such as the Split Hopkinson Pressure Bar enable low-temperature, high-strain materials evaluation to temperatures as low as -80°C. Other equipment include thermal cycling chambers that allow for thermal cycling from -100 to 100°C and a specially fabricated UV-Radiometry system for exposing testing materials to controlled doses of radiation.

Technical Information Analysis Center (TIAC) - CRREL

The TIAC serves DoD and the Nation as the most comprehensive source of cold regions information in the world. The 24,000 square foot TIAC provides a gateway to the world's information and research resources for cold regions science and engineering. The Cold Regions Science and Technology Information Analysis Center (CRSTIAC) serves as the Nation's corporate repository for cold regions science and engineering data. This center houses the CRREL library, which contains 30,000 books, 160,000 reports, 450 journals, 450 rolls of microfilm, 250,000 pieces of microfiche, 40 CD-ROM reference titles, and topographic maps of all 50 states. The Bibliography on Cold Regions Science and Technology, comprising 53 volumes dating from 1951, is prepared for CRREL by the Library of Congress and contains approximately 250,000 citations, including cumulative author and subject indexes.

Coastal Facilities - CHL

Approximately 400,000 square feet of space for three dimensional, high-precision coastal models and experiments. Contains over 850-ft of spectral wave generators (including a 90-ft long Directional Spectral Wave Generator) designed to reproduce waves of 2-ft in height.

EQUIPMENT/FACILITIES

Field Research Facility, Duck, NC - CHL
This facility is recognized worldwide for cooperative multi-national and multi-agency high-precision field experiments in coastal and nearshore processes. The facility consists of 175 acres with a 1970-ft concrete and steel pier, 1 mile of beachfront, full suite of installed coastal processes instrumentation, special purpose beach and amphibious vehicles, etc.

RipRap Experimental Facility - CHL
The RipRap Experimental Facility is the largest curved channel experimental facility in the world, used for study of effects of channel bendways on flow fields, specifically aimed at developing design criteria for riprap protection of bendways.

Hydraulic Engineering Experimental Facilities - CHL
This facility consists of approximately 2,500,000 square feet of space under roofs for models used in high-precision experiments relating to rivers, estuaries, hydraulic structures, and navigation.

Triaxial Earthquake and Shock Simulator (TESS) - CERL
The United States' first large triaxial shaking table is a unique dual-mode shock and vibration test facility. The TESS, in its biaxial mode, simulates a wide range of transient shock vibrations typical of military applications requiring large accelerations over a wide frequency range with moderately heavy test specimens. In the triaxial mode, it can simulate a variety of vibration environments including earthquakes and random vibrations, as well as log-sweep and resonant searches. The TESS is one of the premier seismic experimental test facilities in the country.

Strong Wall Structural Load Floor Testing Facility - CERL
The structural load floor is a 120 ft. by 40 ft. strong floor with the capability to provide complex static and dynamic loading patterns to large-scale structural models of buildings, building components, and structural beams. The facility includes a high bay testing area with a 20-ton capacity overhead crane with a maximum clearance of 34 ft, and a new reaction wall. The facility includes a hydraulic loading system consisting of a series of independent closed loop controlled actuators, which can be placed as required to develop complex loading patterns under static or dynamic conditions, and a large array of loading jacks for tests which are purely static. Computer controlled data acquisition systems are available with capacities of up to 200 data channels. This facility is a unique resource because it is one of only a few in the country capable of performing structural tests on large-scale and full-size structures.

Ion-Plating Systems - CERL
The Ion-Plating System was custom-designed to meet highly specialized research specifications to do small-scale prototype thin film coating experiments. It's the only facility of this kind (plasma-assisted physical vapor disposition) in the Army.

Heating, Ventilation and Air Conditioning (HVAC) Test Facility - CERL
A large 'mini-facility' with four rooms (zones) that can be thermally controlled separately to replicate a variety of HVAC systems and conditions. The facility can model dual or single duct and variable or constant air volume conditions; includes ventilation system, hot water supply loops, chilled water supply loops, HVAC systems configuration, facility controls, and data acquisition system. This facility was used to validate the energy thermodynamics analysis program and to analyze performance of proposed standard digital control panels unique within DoD.

EQUIPMENT/FACILITIES

Acoustics Laboratory - CERL

The Impulse Noise Technology Center is a state-of-the-art lab facility for the quantification and reduction of impulse noise from cannon, helicopters, blast and small caliber weapons firing. Contains a variety of sophisticated noise monitoring, recording, and analysis instrumentation for research on impact assessment and mitigation of impulse noise related to human annoyance and animal disturbance. Also includes a one-of-a-kind noise impedance tube for the test of noise energy absorption along surfaces.

Paint Laboratory - CERL

The Paint Laboratory contains specialized equipment necessary to perform Qualified Product List testing on paints used by the Army (an 'honest broker' function). The laboratory has the capability to manufacture lab size batches of experimental coatings, perform both real-time and accelerated performance testing of coatings, and perform forensic analysis of paint samples.

Controlled Archeological Test Site (CATS) - CERL

The CATS facility has been constructed with funding provided by the National Center for Preservation Technology and Training and will be utilized for research and training with geophysical applications in archaeology. The CATS facility replicates a range of archeological features commonly encountered in North American archaeological sites and offers a controlled environment for the application of non-destructive investigative techniques. The CATS facility will be available for research in a broad range of problems associated with archaeogeophysics such as the effects of environmental conditions on geophysical expression, sensor type and configuration, spatial resolution, image processing and pattern recognition, operator variation, and feature variability.

Engineer Research and Development Center
Vicksburg, MS 39180-6199
(601) 634-2504
Director: Dr. James R. Houston
Commander: COL James S. Weller

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.718	N/A	N/A	0.718
6.1 Other	6.977	0.113	16.942	24.032
6.2	70.204	0.874	76.607	147.685
6.3	18.922	0.308	44.358	63.588
Subtotal (S&T)	**96.821**	**1.295**	**137.907**	**236.023**
6.4	1.094	0.018	4.196	5.308
6.5	0.062	0.002	6.421	6.485
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	74.145	1.030	24.424	99.599
TOTAL RDT&E	**172.122**	**2.345**	**172.948**	**347.415**
Procurement	0.000	N/A	24.396	24.396
Operations & Maintenance	18.033	N/A	45.420	63.453
Other	0.000	N/A	0.125	0.125
TOTAL FUNDING	**190.155**	**2.345**	**242.889**	**435.389**

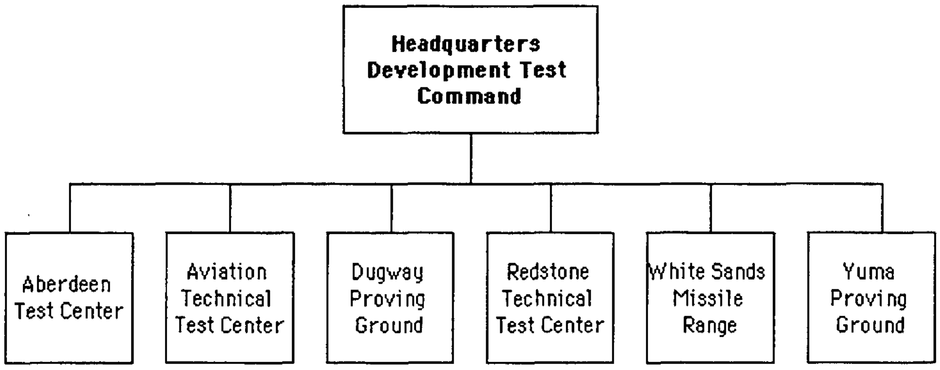
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.125

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	17	17
CIVILIAN	268	788	919	1975
TOTAL	**268**	**788**	**936**	**1992**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	2661.230	**REAL PROPERTY**	542.417
ADMIN	441.120	* NEW CAPITAL EQUIPMENT	17.617
OTHER	345.770	**EQUIPMENT**	605.247
TOTAL	**3448.120**	* NEW SCIENTIFIC & ENG. EQUIP.	2.663
ACRES	**862**	* Subset of previous category.	

HQ Development Test Command

FY2000 Abbreviated Functional Chart - Technical Organizations



HQ Development Test Command

Aberdeen Proving Ground, MD 21005-5055
(410) 278-1017

Commander: BG Dean R. Ertwine
Deputy to CG: Brian M. Simmons

MISSION

The mission of the U.S. Army Development Test Command is to:

- Plan, conduct, and report tests (including developmental, production, live fire, and other tests) and simulations across the full spectrum of environments
- Verify the safety of Army systems
- Develop and procure new test technology, test instrumentation, and selected models and simulations
- Manage assigned installations.

CURRENT IMPORTANT PROGRAMS

Test Management (See specific programs at subordinate test center reports)

Installation Management/Base Support

Virtual Proving Ground

Army Family Housing Management Support

Environmental Management Support

Production Base Support

EQUIPMENT/FACILITIES

Headquarters US Army Developmental Test Command is a tenant at US Army Garrison, Aberdeen Proving Grounds.

HQ Development Test Command
Aberdeen Proving Ground, MD 21005-5055
(410) 278-1017

Commander: BG Dean R. Ertwine
Deputy to CG: Brian M. Simmons

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.000	0.000	0.000	0.000
6.3	0.000	0.000	0.000	0.000
Subtotal (S&T)	**0.000**	**0.000**	**0.000**	**0.000**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	23.461	0.000	23.461
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**0.000**	**23.461**	**0.000**	**23.461**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	1.834	N/A	0.000	1.834
Other	0.230	N/A	0.000	0.230
TOTAL FUNDING	**2.064**	**23.461**	**0.000**	**25.525**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	
TYPE	DOCTORATES	OTHER		END STRENGTH
MILITARY	0	0	11	11
CIVILIAN	2	71	108	181
TOTAL	**2**	**71**	**119**	**192**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	0.000	**REAL PROPERTY**	0.000
ADMIN	0.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	0.000	**EQUIPMENT**	0.000
TOTAL	**0.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**0**	* Subset of previous category.	

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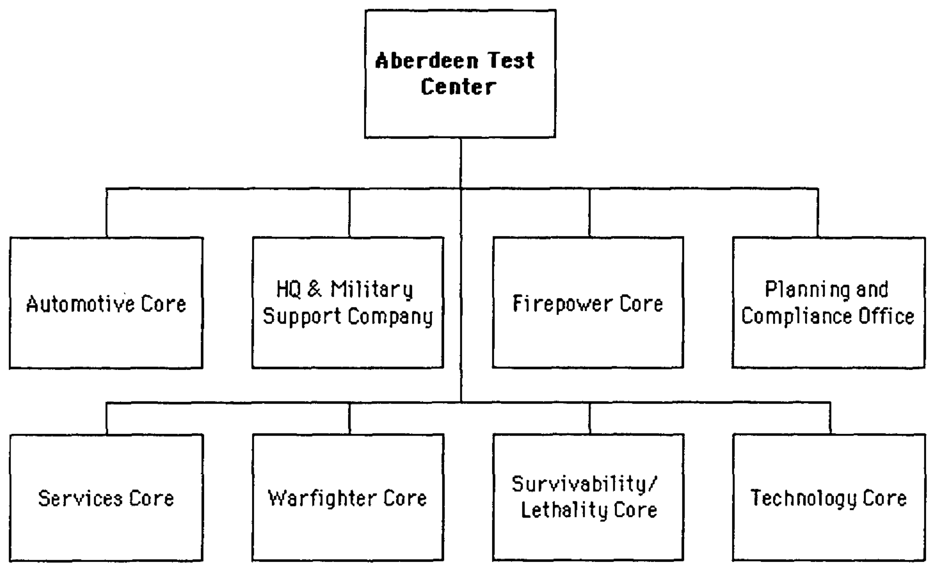
Aberdeen Test Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Aberdeen Test Center
Aberdeen Proving Ground, MD 21005-5059
(410) 278-3574

Commander: Andrew G. Ellis, COL, FA
Technical Director: James W. Fasig

MISSION

Aberdeen Test Center (ATC) is the most diverse test facility within DoD, testing a broad spectrum of military weapons systems and equipment including armored vehicles, guns, ammunition, trucks, bridges, generators, night vision devices, individual equipment (boots, uniforms, helmets, etc.) and surface and underwater marine systems. As a multi-purpose proving ground, with a temperate climate, our primary mission is to plan, conduct, analyze and report on projects supporting research, development, test and evaluation (RDTE), design, engineering, production, surveillance and operational tests for DoD and other government agencies, contractors, foreign government, and private industry. In this single location, ATC can subject an item to a full range of tests from automotive endurance and full weapons performance with environmental extremes, to full-scale live fire vulnerability/survivability/lethality testing utilizing an extensive array of test ranges/facilities, simulators and models. In addition to testing domestic systems, we exploit foreign sytems to assess the enemy threat. We also develop state-of-the-art test procedures (DoD, International), methodologies and instrumentation in order to meet the test requirements of advancing military technologies. ATC is partnered with CINCLANTFLT forming the Chesapeake Regional Range Cooperative which provides air, land and sea test and training support to the joint warfighter. ATC's Military Environmental Technology Demonstration Center demonstrates and validates environmental technologies and guidance for the U.S. Army Environmental Quality Technology Program and the U.S. Army Environmental Technology User Requirements.

CURRENT IMPORTANT PROGRAMS

Medium Tactical Vehicle Replacement (MTVR) for the 5-ton Truck (Marine Version)
Support for Brigade Combat Team Source Selection
Assembled Chemical Weapons Assessment Program
Bradley Fighting Vehicle System (BFVS), M2A3 & M3A3 RAM-D and Performance Test
Tactical Quiet Generator Set (TQG), 30 & 60 KW Reprocurement w/Replacement Engines
Chemically & Biologically Protected Shelter System
Wolverine Production Verification Test
Heavy Dry Support Bridge (HDSB) Production Prove-Out Test Candidate
M829E3 Cartridge, 120MM APFSDS

Technology Transfer Efforts:

Volvo/ATC/Department of Transportation - Under a cooperative agreement ATC/Volvo/Department of Transportation are addressing the Intelligent Vehicle Initiative (IVI) - a study of vehicle safety systems. A two year program is forecasted and will involve 100 trucks in an operational environment with nationwide coverage. Multiple data bus monitoring, analog sensors and GPS time/location with pre-and post-trigger time history records, continuous histograms, event recording and daily data retrieval through Internet accessible databases will be provided.

EQUIPMENT/FACILITIES

WORLD-RENOWNED-FACILITY

Munson Test Area: Automotive field test area consisting of 9 miles of roadways/test courses encompassing 150 acres; paved-2200'; sand course-500'; Belgian Block Course-3900'; wave course-440'; vertical walls 18" to 42" H; slide slope, 20% to 40%, 100' to 700'; simulated loading ramp-40', 20 degrees; improved gravel road 10, 700'; abrasive mud course-950'L X 240'W; 2 and 6 inch washboards-800'; 2 to 4 inch radial washboard-240'; 3-inch spaced bump course-760';longitudinal slopes, 5% to 60%, 80' to 480'; shallow and deep fording basings- 270'L C 6'D, 315'L X 20'D; amphibious vehicle swim area (Spesutie Narrows/Chesapeake Bay).

Perryman Test Area: Level cross-country, secondary and paved road vehicle endurance and reliability test area; six primary test courses cover about 2,000 acres; 3-mile straight and level paved road with turnarounds; two secondary roads, 2.4 miles and 3.2 miles; four cross-country courses of varying severity, 1.8 miles to 5.2 miles; off-road courses vary from moderate gravel surfaces to extremely rough terrain including marshy areas; supports other vehicle tests (i.e., braking, stability, road vibration, steering, etc.).

Churchville Test Area: Hilly cross-country tracked and wheeled vehicle endurance and reliability test area; 250 acres with 11 miles of interconnecting roads and test courses; 7% to 29% grades; 3-mile and 4-mile winding closed loop courses; mud, dust, and gravel surfaces; temperate climate; 4-bay maintenance shop; complete coverage with telemetry/on-board instrumentation; slopes are prepared by tilling and water supply is available for wetting.

Dynamometer Course: Bituminous concrete straight roadway, 1 mile long, 17 feet wide, with oval turnarounds at both ends used for field dynamometer test course; level within 0.1%; supports vehicle performance tests such as drawbar pull,tractive resistance, acceleration and braking and fuel consumption; mobile dynamometers provide load absorption capability up to 100,000 pounds.

Mile Loop: Continuous concrete surface test course consisting of level, parallel 1/4 mile segments connected by 1/4 mile banked semicircular sections at each end; 1-mile long oval paved course; a butting exterior oval gravel course; special-purpose vehicle test courses located within the loop-pothole course, 1-inch bump course, 6-inch cross-tie course; winch test area with 1,000,000-pound capacity anchor (deadman).

Lift and Tie Down Facility: Proof-load testing capability which satisfies the required provisions of MIL-STD-209H and MIL-STD-913; capable of applying lift loads up to 500,000 pounds and tie-down loads up to 200,000 pounds; includes real-time video and acquisition instrumentation; accomodates test items up to 20' wide.

Automotive Tilt Table: Facility for tilting vehicles to determine static roll and/or pitch stability; solid flat platform measuring 100' long by 14' wide; width expands to 25' at midsection; lift capacity-700 tons (uniform loading); maximum tilt angle of 40 degrees (84%) (greater angles possible with alternative configuration).

EQUIPMENT/FACILITIES

Automotive Test Facility Instrumentation: Supports technical and engineering tests addressing performance and reliability, availability, maintainability, (RAM) issues for automotive, fire control, road shock and vibration, transportability and environmental; resources to plan and conduct testing, and collect, analyze, and report test data - approximately 100 personnel, approximately $50M of instrumentation and over 30,000 square feet of laboratory and shop space; initial staging point for test preparations, instrumentation installation, and verification and centralized data collection/reduction.

Land Vehicle Maintenance Facility: 45,000 square feet of interior bay space includes 13 maintenance bays; electric battery shop; engine test cell; closed loop steam cleaning facility; maintenance/diagnostic analysis to direct support/general support level for prototype, standard/production, and foreign systems; rebuild capability for electrical components/systems, hull/chassis assemblies, and power train components; 90,000-pound lift system.

Foreign Systems Test Facilities: Provides a critical mission capability for the technical exploitation of Threat Combat Systems; test and maintenance facility encompassess several buildings utilized for a wide variety of test sponsor requirements; key features are approximately 10 acres of inside and outside storage for vehicles and major assemblies; 14 combat vehicle indoor maintenance and storage bays with secure capability for classified hardware; proximity to tank access roads leading to the Perryman Test Area, Tank Gunnery Ranges, the National Ground Intelligence Center/203rd Military Intelligence Complex, and the Phillips Army Airfield Cargo Loading Ramp.

Moving Target Simulator (MTS): Air supported 100' radius hemisphere provides a 'laboratory' environment for assessing weapon control systems and determining hit probability; controlled, repeatable stationary vehicle/moving target test scenarios; computer-generated stationary, moving, and evasive ground and aerial targets using a laser beam steering system; thermal target capability; instrumentation acquires data such as video scoring, weapon and thru-sight video, data bus activity, weapon system/component performance, target position, etc.

Evasive Target Firing Range (Tank Warfare I): Direct fire range for assessing tank fire control systems under stationary and moving testing item/target scenarios; computer-controlled evasive laser beam ground target projected on a replaceable, reflective surface; thermal target capability; target ranges to 3000 meters; limited capability for gunnery and crew training exercises; gravel,bump, zig-zag and natural earth terrain test courses; instrumentation acquires data such as target scoring, projectile velocity, meteorological, thru-sight and weapon video, data bus activity, and test system performance; training devices are available for system capability testing; on-site maintenance facility.

Multiple Target Firing Range (Tank Warfare II): Highly instrumented stationary vehicle/stationary target direct firing range designed to determine interactions of fire control system, weapon, ammunition, and weapon mount; two lines-of-fire to accomodate depleted uranium and 'live' high-explosive projectiles; multiple targets to 3000 meters; velocity profile via Doppler radar; real-time measurement of jump, projectile miss distance, boresight retention, trajectory mismatch, aim error, weapon system implementation error, and hit probability; instrumentation system includes weapon and thru-sight video, target scoring, projectile velocity, data bus acquisition, weapon system/component measurements, and meteorological data.

EQUIPMENT/FACILITIES

Turret Maintenance Facility (Tank Warfare): On-site tank/turret maintenance areas include 80' X 60', 60' X 60', and 50' X 50' shops and 40' X 100' office space; outdoor roof secure storage area, 120' X 80'; classroom and hands on training facilities; direct support maintenance and electronic troubleshooting; extensive technical manual library; conference facilities for planning and coordination; command/control and training support equipment for system tests; software test and analysis; armament accuracy check sight synchronization/boresighting range.

Tank Armament Test Range (H Field): Direct fire multirange test area for evaluation of tank armaments sytems under moving and stationary tank and target scenarios; gunnery and crew training exercises; moving target and pop-up targets; four target ranges to 3000 meters; 5000-meter range for long-range firing; various terrain courses - gravel, bump, zig-zag, and natural earth; water range for amphibious activities; instrumentation acquires various data-video based target scoring and location, projectile velocity, meteorological, weapon and thru-sight video, test system performance, data bus; 4-bay maintenance facility with secure area.

Multiple Small Arms Firing Ranges and Facilities: Multiple ranges designed and equipped to handle all phases of small arms and light automatic cannon testing. Instrumented ranges also available to conduct precision accuracy firings and general small arms tests. Facilities also available to permit total containment of small arms firing.

Accelerated Corrosion Complex: Provides aggressive controlled exposure of corrosive conditions to land sytems to hasten their weathering process and determine susceptibility to the environments; incorporated into durability test cycle comprised of selected test courses; includes a series of individual corrosive environments-Mist booth-60'L X 15'W X 15'H up to 3-minute mist applied to top and vertical surfaces; Splash trough- 75'L X 20"W, solution depth up to 2 inches subjected to undercarriage; Grit trough 75'L X 14'W, slurry depth up to 8 inches subjected to undercarriage; Humidity booth-40'L X 15'W X15'H up to 160 degrees F, 1 to 2 ml/hr condensate; facilities and equipment provide identification, analysis, and documentation of corrosion.

Fire Safety Test Enclosure (FIREBOX): Designed for full scale fire suppression testing and environmental technology studies; environmentally sound enclosure - internal dome design will completely contain and recover all test fluids and gaseous effluents produced during testing; 84' in diameter and 62' high pressure vessel covers a 4 inch thick X 54' deep X 57' high fragmentation shield; accomodates full-u vehicles; static or dynamic detonations; able to contain a 75'-pound TNT equivalent detonation; full-scale vulnerability and insensitive munitions testing; asset protection system embedded into fragmentation shield and stand pipes on floor.

Vehicle Vulnerability/Survivability Test Range (AA5): Range designed for the vulnerability/lethality testing of domestic and foreign vehicle system targets. Threat launch mechanisms include direct fire at ranges up to 1000 meters; static detonations of warheads, mines, artillery, and top attack munitions (70' tall warhead tower); and dynamically fired ATGMs at attack angles up to 85° via horizontal and elevated rails. Highly instrumented to obtain strain, acceleration, shock, pressure, toxic fumes, temperature, forces and moments on crew, and velocity, pitch and yaw of threat projectile. Real-time video, high-speed video/film/digital imaging available. Remote viewing, monitoring, and control of test item. Fire suppression system for test asset protection. Environmentally friendly test pads channel fluid spills to a holding tank.

EQUIPMENT/FACILITIES

Underwater Explosions (UNDEX) Test Facility: Capability of testing UNDEX shock to MIP-SPC-901, torpedoes, warheads, missiles, amphibious vehicles, ROVs, underwater gun firings, and acoustics; available for joint test and training exercises, submarine systems and subsystems air blasts, air-to-water/air-to-ground/ground-to-ground gun firings; elliptical shape of 1070' long by 920' wide, with a depth of 150'; flat-surfaced bottom diameter of 300'; slide slopes of 2.0:1 to 2.5:1; pond perimeter lined with stone to prevent erosion from wave action; maximum charge weight 4100 pounds TNT equivalent; marine rail launch and recovery system (700' long, up to 220-ton load) capstan/bollard system around pond perimeter; concrete working platform with electrical service and welding pits; barge wet slip for delivery of test items directly from Chesapeake Bay; hydraulic bogie and gripper jack system for transporting large test models from the barge to the launch cradle; 250-ton cranes, barges, 200-ton heavy transport trailer, support boats, man lift; extensive dive services.

Other Facilities/Capabilities:

- Automatic Weapons Elevation - Depression
- Recoiless Rifle Ranges
- Direct-Fire Ranges B-1/B-2/B-3
- High Velocity and Barricade C Ranges
- Ammunition Assembly Plant
- High Explosives Plant
- Rough Handling Testing
- Vibration
- Inspection and Evaluation
- Experimental and Acceptance Weapons
- Industrial X-Ray
- Metrology
- All-Caliber Soft Recovery and Vertical Firing Positions
- Ballistics Range
- Multi-Purpose Indirect-Fire Range
- Indirect-Fire Proof and Recovery Ranges
- Romney Creek 8000-Meter Mortar Range
- Tracking Radar
- Developmental Firing Range at Wallops Island
- Multi-Caliber Fragmentation Facility (Poverty Island)
- Land Mine Test Facility
- Firing Impulse Simulator (FIS)
- Climatic Simulation Facilities/Capabilities
- Electromagnetic Interference Test Facility (EMITF)
- Environmental Chambers
- Bridge Test Sites
- C41.1/Shelter Maintenance and Operation Facility
- Clothing and Individual Equipment Test Areas
- Footwear Durability Course
- Tentage Facility (Mile Loop)

EQUIPMENT/FACILITIES

- Material-Handling Equipment Test Site
- Generator Test Facility
- Human Factors and Air Flow Test Facility
- Human Factors Engineering (HFE) Mobile Data Acquisition System
- Joint Warfighter Range Complex
- Analytical Chemistry Laboratory
- Health Physics Team and Radiochemistry Laboratory
- Materials and Evaluation Testing (Chemistry)
- Toxic Fumes and Field Testing (Chemistry)
- Materials Laboratory
- Materials Testing School
- Multimedia Production
- Rail Transport Facility
- Phillips Army Airfield
- External Air Transport
- Internal Air Transport
- Army Pulse Radiation Facility
- Aircraft Vulnerability Airbase Ranges 3 and 4
- Armor/Antiarmor R&D Range (C Field)
- Internal Blast Test Site (Briar Point Range-Position 3)
- Ballistic Test Site Terminal
- Intermediate Fire Laboratory (IFL)
- Depleted Uranium (DU) Containment Facility (SUPERBOX)
- Depleted Uranium Disassembly Facility
- Live Fire Toxic Fumes Test Facility
- Spesutie Island Vulnerability Ranges
- Indoor Armor Test Ranges
- Outdoor Armor Test Ranges (Six Ranges)
- Supersonic Ballistic Test Rail (L-Field)
- Signature Measurement Test Facility
- Experimental Fabrication Facility
- Surface Ship Systems Survivability (S4) Test Site
- UNDEX Pond at Briar Point Test Range

Aberdeen Test Center
Aberdeen Proving Ground, MD 21005-5059
(410) 278-3574

Commander: Andrew G. Ellis, COL, FA
Technical Director: James W. Fasig

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.077	0.001	0.046	0.124
6.2	3.320	0.039	1.973	5.332
6.3	0.343	0.004	0.204	0.551
Subtotal (S&T)	**3.740**	**0.044**	**2.223**	**6.007**
6.4	2.522	0.029	1.498	4.049
6.5	6.566	0.078	3.902	10.546
6.6	26.991	0.320	16.040	43.351
6.7	0.004	0.000	0.002	0.006
Non-DOD	1.113	0.013	0.663	1.789
TOTAL RDT&E	**40.936**	**0.484**	**24.328**	**65.748**
Procurement	11.656	N/A	6.845	18.501
Operations & Maintenance	7.537	N/A	4.426	11.963
Other	16.991	N/A	9.979	26.970
TOTAL FUNDING	**77.120**	**0.484**	**45.578**	**123.182**

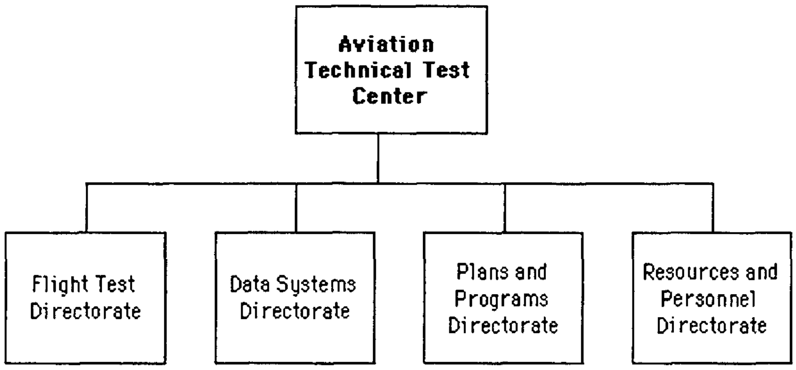
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	1	4	5
CIVILIAN	5	211	526	742
TOTAL	**5**	**212**	**530**	**747**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	123.720	**REAL PROPERTY**	580.700
ADMIN	137.800	* NEW CAPITAL EQUIPMENT	0.213
OTHER	1006.630	**EQUIPMENT**	169.700
TOTAL	**1268.150**	* NEW SCIENTIFIC & ENG. EQUIP.	1.010
ACRES	**56707**	* Subset of previous category.	

Aviation Technical Test Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Aviation Technical Test Center
Fort Rucker, AL 36362-5276
(334) 255-8000

Commander: COL Austin R. Omlie
Technical Director: Larry E. Eagerton

MISSION

Plan, conduct, analyze, and report on airworthiness qualification and developmental testing of aircraft, aviation systems, and associated equipment during development and throughout the materiel life cycle to optimize Army Aviation warfighting capabilities as well as meeting the requirements of the joint services, Federal agencies and the commercial aviation sector.

CURRENT IMPORTANT PROGRAMS

ADVANCED THREAT INFRARED COUNTERMEASURES (ATIRCM). ATTC is assisting Program Manager (PM) Aviation Electronic Systems (AES) during the development of ATIRCM, an Acquisition Category IC program currently in Engineering and Manufacturing Development (EMD). ATIRCM is designed to replace the following aircraft survivability equipment (ASE) on selected Army aircraft: AN/ALQ-144A infrared (IR) countermeasure set, AN/ALQ-156 missile detector, and AN/AAR-47 missile detector. The improved countermeasure dispenser (ICMD), included in the ATIRCM system, is designed to replace the M-130 chaff/flare dispenser. The test aircraft is an EH-60A with the ATIRCM system installed. The aircraft was modified to emulate the external profile of an MH-60K (minus the fuel probe and external tank system). This test asset has allowed ATTC to support Contractor Qualification Testing (CQT) and Potential False Alarm Source (PFAS) testing. Later, it will be used to support government developmental and operational testing.

BRILLIANT ANTI-ARMOR (BAT) PRE-PROGRAMMED PRODUCT IMPROVEMENT (P3I). ATTC is supporting the PEO, Tactical Missiles in its development of the BAT P3I submunition. This submunition is designed to use acoustic sensors to locate targets, then use a combination of IR and MMW sensors in the seeker head to identify and guide the submunition to the target. ATTC has been providing a UH-60 helicopter equipped with contractor sensor systems and instrumentation from Northrop Grumman Corporation (NGC). This airborne platform supports NGC out of Baltimore-Washington International Airport during Continuous Captive Flight Test (CCFT) of BAT P3I sensors to assist in algorithm development. Additionally, the modified Black Hawk is used during Captive Flight Tests (CFTs) to gather data for the government to evaluate performance and functionality of different sensor modes against both moving and stationary target arrays. Testing will continue throughout FY01.

JOINT SHIPBOARD HELICOPTER INTEGRATION PROCESS (JSHIP). ATTC is supporting the JSHIP Joint Test & Evaluation (JT&E) Office to improve the interoperability and safety of all service helicopters with Navy Air capable ships in order to increase combat capability for helicopter units and reduce ship combat vulnerability caused by restrictive operations. JSHIP's charter is to address compatibility, procedures, and training issues related to joint shipboard helicopter operations with the goal of enhancing the safety of joint operations and to develop the processes required to integrate any aviation capable ship and helicopter pair to operate in joint environments. To accomplish its purpose, JSHIP is conducting a coordinated set of land-based and at-sea test activities, ground tests, and man-in-the-loop flight simulator tests. The JSHIP JT&E combines characteristics of developmental testing (in the Dynamic Interface Modeling and Simulation System (DIMSS) process) and operational testing (in

CURRENT IMPORTANT PROGRAMS

Compatibility, Procedures, and Training issue resolution). A total of 12 Dedicated At Sea Tests (DASTs) are scheduled for JSHIP from FY 00-03. ATTC has participated in DASTs 1, 2, and 3 with an instrumented UH-60 Black Hawk, Experimental Test Pilots, and/or Flight Test Engineer Support and will continue to support JSHIP with aircraft and personnel.

AIR WARRIOR SYSTYEM. The Air Warrior System is designed to furnish the Army aviation community with a mission-tailorable system that provides survival equipment, biological and chemical protection equipment, and clothing for aircrew personnel during flight and ground operations. ATTC has developed a Quick Disconnect Wiring Assembly (QDWA) that will provide single point connection of the varied systems the aviator requires during aircraft operation. The QDWA also provides hands-free quick disconnect for emergency egress. The QDWA will be used on the OH-58D(R). ATTC has also developed an installation kit for the Microclimate Cooling Unit (MCU) that will use cold liquid to reduce the aircrew member's body core temperature during MOPP4 or hot weather operations. Installation kits were designed for the UH-60A/L, the CH-47D and the OH-58DR. ATTC will continue to support Air Warrior development through Engineering and Manufacturing Development (EMD) with verification testing, developmental testing and operational testing.

RAH-66 COMANCHE TEST PROGRAM AND FLIGHT TEST. ATTC, as an integral part of the Comanche Combined Test Team, continued Comanche flight test activities in 2000 at the Sikorsky Development Flight Center in West Palm Beach, FL. The focus of testing included the support of ongoing design efforts related to the Engineering & Manufacturing Development (EMD) configuration (which will include Aircraft #3-15). Aircraft #1 & #2 each exceeded previous records for annual flight hour totals by a significant margin, and the flight envelope for Aircraft #2 was expanded to that of Aircraft #1. Significant accomplishments included flight testing with the mast mounted Comanche Radar aerodummy, full envelope expansion with open weapons bay doors, installation of the low observable main rotor hub fairing, and an adjustable surrogate tail (used to investigate directional stability, handling qualities and tail buffet issues). Flight-testing also focused extensively on slope landing investigations, flight control software development, and aft center-of-gravity and high altitude envelope expansion.

OH-58D(R) CONTROL DISPLAY SYSTEM VERSION 4. ATTC was teamed with Yuma Proving Ground, Arizona; Bell Helicopter Textron, Incorporated; Honeywell Systems, and the Scout Attack Project Manager's Office to evaluate the next-generation improved master processor unit (IMCPU) and software. Testing included evaluation of all aircraft functions including communications, flight controls, and navigation and weapons systems. Communications testing included the evaluation of the digital Joint Variable Message Format (JVMF) capabilities for use in the Division Capstone Exercise. Flight controls testing included a preliminary airworthiness evaluation of aircraft with modified stability and control augmentation system (SCAS) control laws. Weapons system testing included an evaluation of the additional weapon firing symbology to the Optical Display Assembly. Testing will continue throughout FY 01.

MODELING AND SIMULATION (M&S). The ATTC M&S Division continues to bring new computer technology and capability to Army aviation T&E. ATTC M&S is integrated into the major focus groups comprising the Army Virtual Proving Ground (VPG) M&S initiative, providing aviation guidance to the VPG Blueprint, Roadmap, and upcoming projects. A Defense Research and Engineering Network (DREN) node was recently installed that connects ATTC with a distributed network of high-performance computing capabilities at other defense sites. The two primary ongoing programs in the

CURRENT IMPORTANT PROGRAMS

ATTC M&S Division are the Mobile Infrared Scene Projector (MIRSP) and the Comanche Flight Simulation Test Station (FTSS). Both the MIRSP and the FTSS were demonstrated at the Army T&E Days in July and the AUSA Conference in October. To support customers in upcoming MIRSP applications, a suite of dynamic scenes have been generated using in-house scene generation tools at ATTC.

Mobile Infrared Scene Projector (MIRSP). The MIRSP system was developed by RTTC and delivered to ATTC in December 2000. The MIRSP will be used to stimulate aircraft installed forward-looking infrared (FLIR) sensors with battlefield scenes, as well as calibrated target images or previously recorded FLIR imagery. This new capability will be transported to the fielded unit under test (UUT) or to sensor and aircraft development facilities. The primary purpose of the MIRSP is to support the Comanche Systems Integration Laboratory (SIL) activity and the Comanche flight-test program. The initial operation capability (IOC) is expected in early 2001 when the existing array is replaced by a newly packaged one.

Flight Simulation Test Station (FTSS). The FTSS is a collection of tools designed to bring M&S capability to the aviation community. ATTC completed the development of the Comanche bearingless main rotor template, fan-tail aerodynamics model using uniform inflow, and high-fidelity flight control system and implemented each into FLIGHTLAB. The West Palm Beach visual database was implemented into the Piloted Rotorcraft Intelligent Symbology Management Simulator (PRISMS). A low-fidelity Comanche flight dynamics model was developed and implemented into the PRISMS hardware. ATTC received High Level Architecture certification for the VPG RAH-66 Comanche Simulation. In the spring of 2001 ATTC expects to take delivery of a full-scale Comanche cockpit shell encapsulating the PRISMS hardware.

EQUIPMENT/FACILITIES

Seventeen rotary and fixed-wing aircraft are currently assigned (4 AH-64, 1 RC-12G, 1 C-23A, 2 CH-47D, 1 EH-60A, 1 OH-58D, 2 UH-1H, 4 UH-60A, 1 UH-60L) as test beds. Helicopter Icing Spray System (HISS): a CH-47D with an integrated 1,800-gallon water tank and spray apparatus combined with a highly instrumented RC-12G to provide cloud physics documentation, conducts in-flight icing evaluations under both artificial and natural conditions. Full flight test instrumentation capability exists. Analog and digital aircraft data can be recorded and/or telemetered to the ground. On-site data processing and display exist real-time and post-mission. Capability to collect and process video, still, and high-speed pictures exists. C-23A aircraft serves as a multi-sensor, configurable test bed for comparative side-by-side testing.

Aviation Technical Test Center
Fort Rucker, AL 36362-5276
(334) 255-8000

Commander: COL Austin R. Omlie
Technical Director: Larry E. Eagerton

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.000	0.000	0.000	0.000
6.3	0.000	0.000	0.000	0.000
Subtotal (S&T)	**0.000**	**0.000**	**0.000**	**0.000**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	0.000	0.000
6.6	10.292	0.000	0.000	10.292
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**10.292**	**0.000**	**0.000**	**10.292**
Procurement	0.625	N/A	0.000	0.625
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	1.130	N/A	0.000	1.130
TOTAL FUNDING	**12.047**	**0.000**	**0.000**	**12.047**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	21	21
CIVILIAN	2	29	54	85
TOTAL	**2**	**29**	**75**	**106**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	0.000	**REAL PROPERTY**	3.600
ADMIN	89.633	* NEW CAPITAL EQUIPMENT	0.000
OTHER	125.004	**EQUIPMENT**	121.039
TOTAL	**214.637**	* NEW SCIENTIFIC & ENG. EQUIP.	0.504
ACRES	**11005**	* Subset of previous category.	

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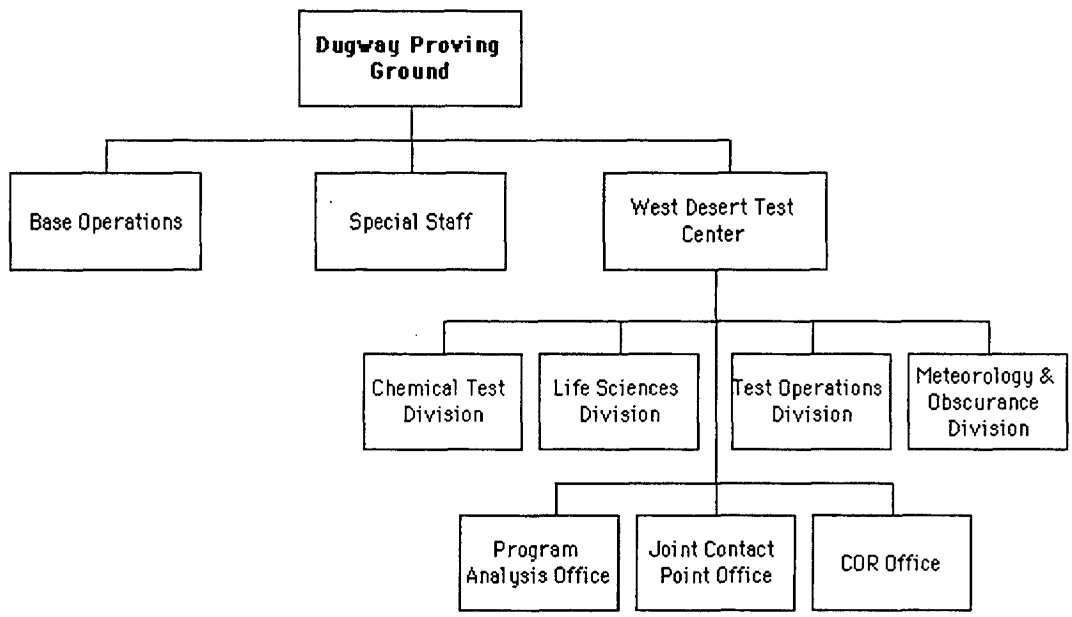
Dugway Proving Ground

FY2000 Abbreviated Functional Chart - Technical Organizations



Dugway Proving Ground
Dugway, UT 84022
(435) 831-3701

Commander: Colonel Edward A. Fisher
Chief Scientist: Dr. William A. Dement

MISSION

To test U.S. and Allied chemical and biological defense systems. Perform NBC survivability testing of defense material. Test environmental characterization and remediation technology. Act as the DoD joint chem/bio defense contact point in support of warfighting CINCs. Provide support to chemical and biological weapons conventions. Safeguard the environment. Operate and maintain an installation to support the test mission.

CURRENT IMPORTANT PROGRAMS

The FY00 research, development and laboratory investigations. Joint-operations chemical and biological defense test and studies for CINCs and Services. Munitions development/acceptance and production testing. Environmental studies to support DPG and Army programs. FY00 important programs include:

- Driver's Vision Enhancement (DVE), for the HMMWV, NBC Survivability Test
- BFVSA3 NBC Contamination Survivability (NBCCS) Verification Test
- Grenade 66mm, Non-Lethal Distraction, XM98 Production Verification
- Grenade 66mm, Non-Lethal Blunt Trauma, XM99 Production Qualification
- PEQ-2A Target Pointer/Illuminator/Aiming Laser
- XM1155 Portable Inductive Artillery Fuze Setter NBC Testing
- Javelin Missile Command Launch Unit (CLU) NBC Testing
- Javelin Joint Venture testing for Raytheon/Lockheed Martin
- Cartridge, 60mm, Practice SR, M766, First Article and 21 Lots, Pocal Industries, BTR 25-97C
- XM767 Cartridge, 60 mm, Illum, Infrared
- M767 Cartridge, First Article and 3 Lot acceptance tests
- XM767 Engineering Lot Acceptance Tests
- M880, 81mm Short Range Practice CTG (SRPC), M987 Ignition Cartridge Test
- Remote Area Denial Artillery Munition (RADAM) NBC Study
- Projectile, 155mm, SMK, WP, M825 (1320-D528) FY00 Ammunition Stockpile Reliability Program (ASRP)
- A898/M672 Fuze Sadarm Projectile 155mm
- XM769 60mm Full Range Practice Cartridge (FRPC)
- XM769 60mm Full Range Practice Cartridge (FRPC) Hazard Classification Testing
- Modular Artillery Charge System (MACS) Paint NBC Survivability Test
- Thermal Weapon Sight (TWS), AN/PAS-13, (BRIDGE) Biological and chemical Decontamination Testing
- C130 Aircraft Characterization of System Function and Dispersion of Released CHAFF, Air Force

CURRENT IMPORTANT PROGRAMS
• Tactical Message System (TMS) NBCCS Analysis • Common Hardward Software (CHS) - NBC Testing • Integrated System Control (ISYSCON) NBC Study • Single Shelter Switch (SSS) NBC Analysis • Urgan Hazard Prediction & Assessment Capability (HPAC) CB Hazard Testing under CANNUSTEP • Field Testing Ground Truth Methodology • Transport Response Experiment (TREX) Project • Wall Study for University of California • VPG - DPG Support • Technical Committee Support • VPG - Remote Detector Characterization • VPG - VVA of ATC 4 DWX • QA Program for Testing and Air Safety • Smoke & Obscurants Data Archiving and Retrieval • VPG - M&S Infrastructure Test Bed • VPG - Joint Database Integration Project - DPG • VPG - Synthetic Environment Integration - DPG • VPG - Point Detector Synthetic Stimulator/Char. • VPG - VPG Support • VPG - Probabilistic CL Model • VPG - M&S for Chamber Testing • VPG - 4DWX • Urban Modeling Program, Defense Threat Reduction Agency • Project VI • Defense Threat/Vulnerability Analysis of Potential Biological Threat Agents • Particle Immuno-Filtration Assay Identifier Trials • Biocide Project • Training Support to WMD/CST Army National Guard • Project VI, USN Special Purpose Clothing Swatch Test • Analysis Capability Support to FBI • U.S. Air Force Operational Test & Evaluation Center (AFOTEC) General Support • Trilaterial Field Testing of Advanced Mitigation Techniques for the Navy • Hot spots Meteorology: Middle East (Assessment) D049 • Anti-Material Chemical/Biological Agents (Assessment) D049 • Water Support in a Toxic Environment D049 • Planning & Initiatives for FY98/FY99 D049 • Clothing Decontamination (Chemical Lab Test) D049 • Cargo Helicopter Interior Contamination Control (Assessment) • Air-Platform Interface Issues during Recovery & Turn-ard CB Agent Contamination Naval Aircraft D049 • Effect of Chem Warfare on Airbase OPS (PA-13)/Impact of MOPP on Aircraft Sortie Generation D049 • Mitigation of CW/BW Effect on Unprotected Civ During Noncombatant Evacuation OPS (PA-11) D049

CURRENT IMPORTANT PROGRAMS
• Agent concentration for onset of Symptoms in Unwarned Unprotected Civ Personnel (PA-14), D049 • Sea Port of Debarkation (SPOD) D049 • CB Technical Data Source Book, VX Update • Planning & Initiatives FY00 D049 • C/B Technical Data Source Book (Biological Agents) • Assessment of Effectiveness of Laundering JSLIST & Aeration of JSLIST (Lab Data) D049 • VX&VX Simulant Pick-up contact Hazard on Asphalt & Conrete (Lab Test) D049 • Assessment of Reaerosolization Associated with Biological Warfare Agents (Assessement) D049 • Air Mobility Study Validation Assessment • Aircraft Environmental Control System (ECS) CB Agent Instruction Investigation • Cargo Cover Material Contamination Testing • Component Testing, Biological Integrated Detector System (BIDS), P3I • BIDS, P3I, JPO-BIO • Supercritical Water Oxidation (SCWO) Sys, Assembled Chemical Weapons Assessment (ACWA) Program • ACWA Set Energetics, Jet Cutter and Dunnage • ACWA Foster Wheeler's Supercritical Water Oxidation • ACWA Technology Testing • Chem Warfare Convention/Treaty Verification - Tech Rep/Consultation (Quick-Reaction) • Chemical Warfare Treaty Testing of Flow Injection Trace Analyzer (Lab Test) • CW Treaty, CBDCOM Screening Kit Evaluation • CW Treaty, Swept Frequency Acoustic Interferometry (SFAI) • Demolition Characterization of the 122mm Chemical filled rocket to Support OSD Gulf War Illness Team • Establishment of Evaporation Rates, VX Studies, Defense Special Weapons Agency (Live Chem Warfare) • Tactical Quiet Generator Set (TQG), 3KW, Re-Buy • Advanced Tactical Power Unit (ATPU), 1.1 mw, Theater High Altitude Area Defense (THAAD) NBC Study • Cargo/Bed Cover (CBC) NBC Decontamination Study • JSFXD, Joint Program (PM NBC Lead) • Sorbent Decontamination System Production Qualification Test • Sorbent Decontamination System (SDS) Decon/Lab Testing • XM50/51 CB Mask Performance/NBCCS Test Methodology Study • HSF Glove - Chemical Test • JIG - CB Chemical Test • JPACE Joint Program (Navy Lead), Baseline Comparison Test • Self-Contained Toxicological Environmental Protective Outfit 35 Mil Glove, Chemical Agent Test • Self-Contained Toxicological Environmental Protective Outfit (STEPO) Neoprene/Butyl Gloves • Joint Vaccine Acquisition Program (JVAP) • Armed Forces Institute for Pathology PCR Multicenter study • Canteen Insert Water Purifier (CIWP)

CURRENT IMPORTANT PROGRAMS
• MTOX Disinfection Pen and the MESO Systems Still ABO Disinfection Test • VX Hydrolysis Study, Phase II • G-agent Hydrolysis Study, Phase I • Methodology Effort - Surface Sampler Probe XM279 for XM22 • Automatic Chem Agent Det Alarm (ACADA) • JCAD, Test Method Study • JCAD, Engineering Test • JCAD PQT Methodology • JSLSCAD Performance Evaluation for Intellitec • Sample Prepartion for Electro-Optical Systems • Biotechnology Characterization by Unconventional Signatures (Bachus Program) • JBPDS • JBPDS, Mini Field Trials • JBREWS, Field Trials • JBREWS, ASEC Chamber Test • JBREWS, Live Agent Test • JBREWS, Military Utility Demonstration • Counter-Proliferation, Bio-Detection Support to Defense Nuclear Agency (DNA) Field Tests at WSMR • Joint Serivces Lightweight NBC Reconnaissance System (JSLNBCRS) • XM94E1 Counterproliferation Long Range - Biological Standoff Detection Sys (CPLR-BSDS) • Short Range - Biological Standoff Detection System (SR-BSDS), Development Field Test • Chemical Agents on Surfaces • AICPS • Scout Smartman and Mist Testing Support to NAVSEA • Standard Integrated Command Post System (SICPS) NBC Contamination Survivability Testing • Divine Umpire-1 Conventional Air-Launched Cruise Missile (CALCM) • Large Diameter Container NBC Survivability Testing • SWMU - Installation Restoration Activities • Installation Restoration Project (IRP) - Chem Lab Analytical Spt to US Army Environmental Center • FY99/00 Support to National Guard Units • FY99/00 Non-Test Support to Tooele Army Depot • FY99/00 Non-Test Support to Army Customers • Data Logger: Pond Tests for Battelle • FY99/00 Support to USAF for Test and Training Programs on UTTR • FY99/00 Demilitarization and Range Clearance

EQUIPMENT/FACILITIES

Instrumented grids for chemical, biological and smoke/obscurant systems. Artillery and mortar ranges for conventional, smoke, an illumination munitions. Ballistics and dissemination tests with field sample, sample mass analysis, and meteorological (auto data acquisition and MESOMET network) system. Physical and environmental test facility chambers for agent containment and MILSTD 810 work. Operations supported by meteorological research on behavior of clouds. Capability for planning analysis, evaluation of tests and operations research. Labs equipped for wide range of chemical, microbiological, toxicological, immunological and pollution studies. Environmental characterization and remediation technology testing. External communication and range safety system. Outstanding features are: large land area, restricted air space, long and flat artillery ranges, projectile recovery, sonic and electromagnetic sterility and diverse technical and scientific skills.

Dugway Proving Ground
Dugway, UT 84022
(435) 831-3701

Commander: Colonel Edward A. Fisher
Chief Scientist: Dr. William A. Dement

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.077	0.000	0.143	0.220
6.3	0.019	0.000	0.036	0.055
Subtotal (S&T)	**0.096**	**0.000**	**0.179**	**0.275**
6.4	0.067	0.000	0.124	0.191
6.5	1.014	0.000	1.884	2.898
6.6	1.409	0.000	1.427	2.836
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.119	0.000	0.221	0.340
TOTAL RDT&E	**2.705**	**0.000**	**3.835**	**6.540**
Procurement	0.738	N/A	0.130	0.868
Operations & Maintenance	22.283	N/A	18.517	40.800
Other	10.659	N/A	28.604	39.263
TOTAL FUNDING	**36.385**	**0.000**	**51.086**	**87.471**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	1	0	7	8
CIVILIAN	19	64	357	440
TOTAL	**20**	**64**	**364**	**448**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	205.000	**REAL PROPERTY**	182.000
ADMIN	132.500	* NEW CAPITAL EQUIPMENT	0.000
OTHER	1866.000	**EQUIPMENT**	73.000
TOTAL	**2203.500**	* NEW SCIENTIFIC & ENG. EQUIP.	3.000
ACRES	**798855**	* Subset of previous category.	

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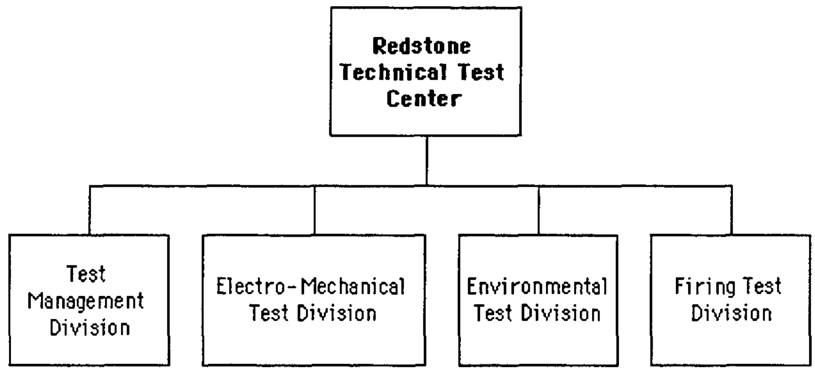
Redstone Technical Test Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Redstone Technical Test Center
Redstone Arsenal, AL 35898-8052
(256) 876-3552

Director: Mr. Carl E. Roberts
Technical Director: Charles Crocker

MISSION

The mission of Redstone Technical Test Center (RTTC) is to plan, conduct, analyze and report the results of technical tests of missile, rocket and aviation components, subsystems and systems while supporting development, production and sustainment of Army materiel (principally tactical missile systems and associated technologies) throughout the life cycle. Additionally, RTTC serves as the Department of Defense (DoD) Lightning Effects Tester for live ordnance and munitions. RTTC provides testing and test support for aviation mission equipment, rockets and missile research, development, test and evaluation and other missions of authorized customers within and outside DoD, to include government and non-government organizations, domestic and foreign.

CURRENT IMPORTANT PROGRAMS

- JAVELIN Missile System
- Aviation Rocket and Missile Systems - HELLFIRE and LONGBOW
- Improved Target Acquisition System (ITAS)
- Improved Bradley Acquisition Subsystem (IBAS)
- Multiple Launch Rocket System (MLRS) - Rockets and Launcher
- ATACMS/BAT
- TOW Missile Systems
- UH-60 Mission Equipment
- AH-64D Launcher
- M72
- Bunker Defeat Munition (BDM)
- Hydra 70
- AMCOM Missile Repair Parts Program
- AMCOM Missile Shelf Life/Surveillance Program
- AMCOM Missile Stockpile Reliability Program (SRP)
- AMCOM Aviation Flight Safety Parts
- AMCOM RDEC Technology Base

EQUIPMENT/FACILITIES

RTTC's facilities are categorized into the broad functional area of Firing, Electro-Mechanical, and Environment Test. The Center offers a single testing organization with 'cradle to grave' test capabilities. Testing begins at the concept design phase with models and prototypes and continues with component, subsystem, and system integration and refinement through the production qualification and first article test phase into sustainment testing of repair parts, conduct of shelf-life and stockpile reliability tests, limited retrofit, etc. RTTC uses mobile data acquisition and test control capabilities to meet test requirements remote from Redstone Arsenal. The Test Management Division provides overall test program management. This group is responsible for test planning, analysis of test criteria, coordination and reporting of all RTTC test activities. RTTC applies advanced testing techniques, an extensive fiber optic network across Redstone Arsenal and a high performance computer to accomplish system level performance tests using distributed, synchronized subsystem test.

EQUIPMENT/FACILITIES

Firing test activities consist of open air range or field testing of rocket/missile systems and subsystems, including target detection, acquisition and recognition technologies. Two test ranges are available for flight test. Test Area 1 (TA-1) is dedicated to R&D testing for advanced technology hardware and projet managed systems. It includes a primary flight test range 8.4 kilometers long with a 45 degree safety fan located on 8000 acres of terrain similar to that found in Northern Europe. A small rockets range and two sled tracks (1000 ft. and 2000 ft.) are also located within TA-1. Full instrumentation, with radar, optical and electronic data gathering capability is available to support surface-to-surface and air-to-surface flight tests. TA-6 is a 3300 meter range adapted primarily to Production Acceptance Flight testing of anti-tank missiles. Extensive optical coverage and radar TSPI are available at this range. Airborne Systems Laboratory, located adjacent to a 2225 meter runway, supports captive carry testing with aircraft, site preparation and instrumentation as well as a complete, mobile IR signature measurement van. RTTC uses a stabilized sensor platform that removes unwanted vibrations for captive carry testing or terrain mapping. TA-3 is a non-firing range used for airborne and ground target acquisition/seeker/laser testing in benign or in "dirty battlefield" atmospheric conditions. RTTC maintains a fleet of US and foreign armored vehicles as targets. RTTC performs static motor firings on systems ranging from small, one shot impulse thrusters to large boosters used to launch satellites. Solid rocket and liquid engine propulsion sections and components are tested at controlled temperatures. Performance testing of hypergolic thrusters used in hit-to-kill systems are performed at simulated high altitudes. RTTC also performs motor dissection, warhead evaluation and insensitive munitions tests at TA-4 and TA-5.

RTTC provides the full spectrum of measurement capabilities to dimensionally inspect and functionally test a wide variety of weapon system subsystems and components. This includes all areas of electromagnetic environmental effects (E3) testing. The E3 group provides detail test design and planning, E3 test conduct, data reduction, analysis and determination of "fixes" if necessary. RTTC has the only known facilities to conduct ESD and lightning effects testing on "live" munitions. Laboratory testing is performed to support model validation and physical or electronic performance of mechanical, electronic, optical and electro-optical and microwave/millimeter wave test items. State-of-the-art laboratory facilities are available to characterize performance of lasers, semi-active laser seekers and imaging infrared seekers and target acquisition systems. Hardware-In-The-Loop, flight or platform motion simulation test fixtures employing real-time scene projectors, temperature conditioning and high performance computer resources are available to provide realistic field test environments. Utilizing advanced modeling and simulation techniques, including high fidelity system models, subsystem test results can be extrapolated to system level performance. The radar system group can test a wide variety of millimeter wave and microwave components and employs both near and far field techniques for antenna metrology.

Environmental testing capabilities include natural and man-made environmental stresses that cover the transportation, stockpile, deployment and flight portions of the life of weapon systems. Non-destructive methods are used to measure and observe environmental effects of the test items. Environments experienced in world-wide deployments are accurately simulated. Environmental stressing is induced at controlled temperatures by dynamic test facilities that perform vibration, shock and acceleration testing. RTTC acquires transportation and deployment field data on a road course located at TA-7 or onboard aircraft and performs data reduction, analysis and specification development for systems and subsystems. RTTC performs modal surveys and analyses for complex vehicles that range in size from a HMMWV to 19 ton solid rocket booster sections. RTTC possesses a variety of both environmental and non-destructive test facilities for component, subsystem and system level test.

Redstone Technical Test Center
Redstone Arsenal, AL 35898-8052
(256) 876-3552
Director: Mr. Carl E. Roberts
Technical Director: Charles Crocker

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.278	0.000	0.000	0.278
6.2	4.287	0.000	0.000	4.287
6.3	1.534	0.000	0.000	1.534
Subtotal (S&T)	**6.099**	**0.000**	**0.000**	**6.099**
6.4	0.198	0.000	0.000	0.198
6.5	3.529	0.000	0.000	3.529
6.6	16.646	0.000	0.000	16.646
6.7	2.186	0.000	0.000	2.186
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**28.658**	**0.000**	**0.000**	**28.658**
Procurement	12.829	N/A	0.000	12.829
Operations & Maintenance	2.266	N/A	0.000	2.266
Other	19.751	N/A	0.000	19.751
TOTAL FUNDING	**63.504**	**0.000**	**0.000**	**63.504**

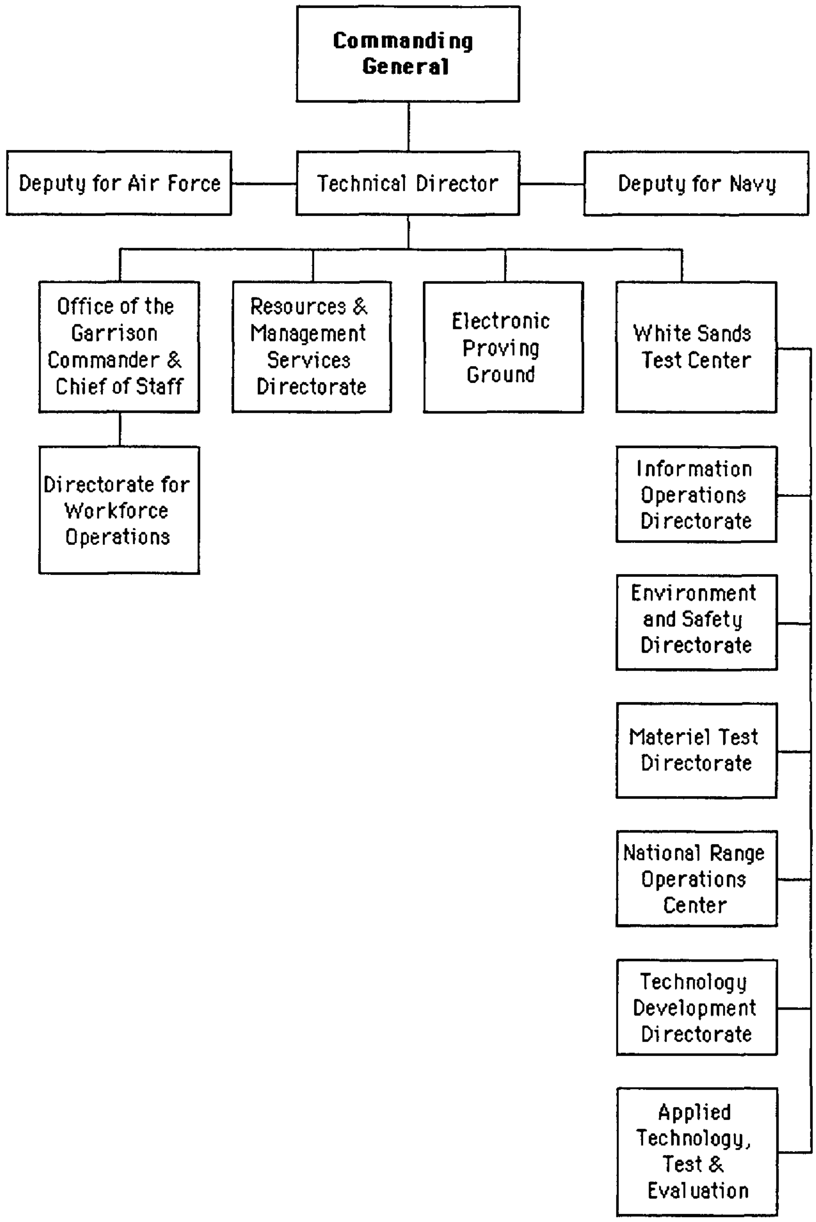
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	0	0
CIVILIAN	0	89	45	134
TOTAL	**0**	**89**	**45**	**134**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	580.000	**REAL PROPERTY**	320.000
ADMIN	62.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	168.000	**EQUIPMENT**	0.000
TOTAL	**810.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**14000**	* Subset of previous category.	

White Sands Missile Range

FY2000 Abbreviated Functional Chart - Technical Organizations



White Sands Missile Range
White Sands Missile Range, NM 88002-5000
(505) 678-1101

Commander: BG Steven W. Flohr
Technical Director: George A. Orlicki

MISSION

The U.S. Army White Sands Missile Range provides quality test and evaluation, research, and other technical services to the Army and Department of Defense (DoD) acquisition programs.

CURRENT IMPORTANT PROGRAMS

- Patriot Advanced Capability 3 (PAC-3)
- Theater High Altitude Area Defense (THAAD)
- Force XXI Battle Command Brigade and Below (FBCB2)
- Army Tactical Missile System (ATACMS)
- Medium Extended Air Defense System (MEADS)
- M1A1 & A2 Abrams
- Multiple Launch Rocket System (MLRS)
- Guided MLRS (GLMRS)
- Navy Research Rockets
- High Mobility Artillery Rocket System (HIMARS)
- CHUSAM Japanese Air Defense System
- Advanced Medium Range Air-to-Air Missile (AMRAAM)
- Bradley Fighting Vehicle
- SCORPIUS SR-S Suborbital Rocket Test Program
- Line of Sight Anti-Tank (LOSAT)
- Navy Standard Missile
- Hera & Storm Missile Targets
- X-34
- Space Shuttle Support
- Support of 57th Test Group, Holloman AFB
- Aim-7E Air-To-Air Missile
- Tactical Internet
- Guardrail Common Sensor
- Battlefield Digitization Applique
- Ground Based Common Sensor
- Warfighter Exercise Support
- Near Term Digital Radio
- Single Integrated Command Post (SICPS)
- Single Channel Ground Airborne Radio System (SINCGARS)
- Global Positioning System (GPS) General Support
- Integrated Meteorological System (IMETS)
- Unmanned Aerial Vehicle
- Asynchronous Transfer Mode

CURRENT IMPORTANT PROGRAMS

- Special Ops Forces Tactical Assured Connectivity
- Defense Advanced GPS Receiver (DAGR)
- AN/PSC-5 Enhanced Manpack User Terminal
- Combat Maneuver Training Center Instrumentation System
- SARSAT/COSPAS Beacon Certification
- Single Shelter Switch
- Multiple Integrated Laser Engagement System (MILES)

EQUIPMENT/FACILITIES

White Sands Missile Range, including the Electronic Proving Grounds (EPG), Fort Huachuca, AZ, has a variety of: (1) test facilities, (2) instrumentation, and (3) features that make it a premier test range. These features include the largest overland test range, White Sands managed restricted airspace, and varied terrain features. White Sands also has range instrumentation which includes instrumentation and airspace surveillance radar, fixed and mobile telemetry instrumentation, remote-controlled optical tracking mounts, modeling and simulation development facilities, and range and target control instrumentation. White Sands also has a complete environmental and scientific laboratory including a Microbiological Test Chamber, Large Environmental Test Chamber, Chemistry Lab, Metallurgy Lab, and Dynamics Lab. The Directorate of Applied Technology, Test, and Simulation (DATTS) has testing facilities such as the Solar Furnace, Electromagnetic Pulse, Linear Electron Accelerator, Electromagnetic Radiation Effects transmitters, and the Large Blast Thermal Simulator. Big Crow is an airborne electronic warfare asset that includes a three mile cable suspended from two mountain peaks. At our EPG site we conduct comprehensive testing of C4I equipment and systems. We use a combination of field testing, bench-type testing, and modeling and simulation to test the large distributed digital systems being proposed for and fielded with the Army digital divisions of the future. We also test Unmanned Aerial Vehicles (UAVs), GPS receivers, emergency beacon systems, individual radios, intelligence systems, and the functioning of various navigation systems. Facilities available include a state-of-the-art antenna facility, EMI/EMC/Tempest test facility, computer modeling and simulation capability, communications test bed, and an instrumented test range. EPG is also the site of a 12,000 foot runway, a number of short UAV runways, and the US beacon testing facility for the verification of commercial emergency rescue beacons. White Sands and EPG are both developing the Virtual Proving Ground, which is a modeling and simulation capability to perform testing using a combination of virtual, live, and constructive entities.

White Sands Missile Range
White Sands Missile Range, NM 88002-5000
(505) 678-1101

Commander: BG Steven W. Flohr
Technical Director: George A. Orlicki

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.213	0.000	0.456	0.669
6.3	1.561	0.000	1.532	3.093
Subtotal (S&T)	**1.774**	**0.000**	**1.988**	**3.762**
6.4	0.321	0.000	0.156	0.477
6.5	64.819	0.000	150.574	215.393
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	4.325	0.000	4.123	8.448
TOTAL RDT&E	**71.239**	**0.000**	**156.841**	**228.080**
Procurement	0.021	N/A	2.453	2.474
Operations & Maintenance	18.123	N/A	80.101	98.224
Other	12.095	N/A	16.542	28.637
TOTAL FUNDING	**101.478**	**0.000**	**255.937**	**357.415**

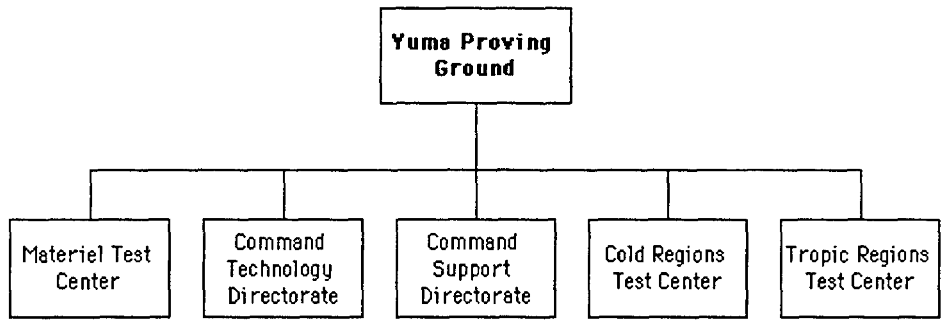
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	60	60
CIVILIAN	11	497	1231	1739
TOTAL	**11**	**497**	**1291**	**1799**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1734.967	**REAL PROPERTY**	509.956
ADMIN	977.702	* NEW CAPITAL EQUIPMENT	25.619
OTHER	2851.736	**EQUIPMENT**	765.443
TOTAL	**5564.405**	* NEW SCIENTIFIC & ENG. EQUIP.	32.558
ACRES	**2281659**	* Subset of previous category.	

Yuma Proving Ground

FY2000 Abbreviated Functional Chart - Technical Organizations



Yuma Proving Ground
Yuma, AZ 85365-9101
(520) 328-2163

Commander: James M. Althouse, Col, EN
Technical Director: James L. Wymer

MISSION

Our focus is on the planning, execution, and reporting of development and production testing of artillery, direct fire, automotive, aviation systems, mines and countermines, UXO systems, air delivery and soldier equipment. We do this in diverse world-wide operating environments (desert, tropic, and cold regions) through application of our experience throughout a systems life cycle.

CURRENT IMPORTANT PROGRAMS

- Crusader
- M1-A2/A3 Abrams Tank
- M-2 Bradley IFV
- Palletized Load System (PLS)
- Search and Destroy Armor (SADARM)
- Tank Main Armament System (TMAS)
- C-17 Cargo Aircraft and Air Delivery System (Advanced Tactical Parachute System, Dual Row Airdrop System, Universal Static Line, Canadian Retrieval System, Short and Long Range Air Lauched Target programs, NASA's Assured Crew Return Vehicle)
- OH-58D Kiowa Warrior
- Unmanned Aerial Vehicle Close Range (UAV-CR)
- RAH-66 Comanche Target Acquisition Systems
- AH-64D Apache Longbow
- Wide Area Mine (WAM)
- Cold Weather Clothing and Equipment
- Foreign Military Testing (SP2000, 120MM MORTAR, Shielder)
- Navy's Extended Range Guided Munitions, ICM Projectile and MARK 399
- Munitions and Weapons Testing (GPS-Projectile; XM982 155MM; M782 Multi-Option Fuze Artillery; Mortar Illumination Cartridges)
- Anti-personnel Landmine Alternative Program (ALAP)
- Production Acceptance of projectiles, charges, and fuzes
- Cooperative Research and Development Agreements with the following: Arizona Public Service for Solar Power Research; Argonne Laboratory for environmental investigation; Los Alamos on laser cutting/hydrolysis of energetic materials; Republic of Panama City of Knowledge for tropic testing; ARO for natural environment study, UXO; and ARL for HSTSS and Instrumentation
- VPG Programs: IMAPS; Desert, Cold Regions, Tropic MERS; Aerial Weapons and Air Delivery M&S; Cooperative integration of IMAPS with DMSO weather M&S

EQUIPMENT/FACILITIES

Laguna Army Airfield Complex: Includes Laguna Army Airfield (C-5/C17 capable), facility hangar, weapons test hangar, Reeder Air Delivery test facility, and Castle Dome Heliport.

Cibola Test Range Complex: Includes UAV test complex, aviation instrumentation systems, 11 drop zones, 7 weapons ranges, weapons arming sites, wire and fiber optic communication networks, improved and unimproved roadways, and a tactical assault landing strip.

KOFA Industrial Complex: Includes weapon & vehicle maintenance facilities; armament and fabrication shops, environmental simulation facilities; ammunition disassembly, storage, and management facilities; 2 ammunition plants and Range Operations Center.

KOFA Range Complex: Includes Armament Operations Center; over 300 gun positions; 10 dedicated impact fields; mine/countermine demolitions complex; ballistic instrumentation system; wire and fiber optic communications, improved and unimproved roads; and dedicated direct fire ranges. Complex offers up to 55 miles range with unlimited restricted airspace. Facilities for production testing of ammunition.

Automotive Test Course Complex: Includes automotive operations center; armor operations center; automotive instrumentation facility, tank hills road course, dynamometer course; dust and mud courses; cross country course; Middle East course; water fording/swimming; 200+ miles road courses; sand dunes & paved mountainous terrain courses available.

Future Technology Support: Smart Weapons Test Range is dedicated to advanced, intelligent munitions, UXO detection and remediation, and solar power research. Combat Systems Test Range is dedicated to fire and movement testing of combat vehicle weapons systems. Electric Gun facility was built to accommodate ARDEC choice of YPG as Electric Gun Test Site. Desert countermine testing and training range being constructed to support the testing and evaluation of mine detection equipment.

Cold Regions Test Center: Includes Bolio Lake Test complex with cold and temperate natural environment testing for aerial, mobility, combat, artillery & rocket, and individual clothing & equipment systems and selected subsystems.

Desert/Cold Regions/Arctic Natural Environmental Test capabilities: Includes a suite of master environmental reference sites for VV&A of modeling and simulation requirements; Provides capability to test systems under MILSPEC climate extremes.

Yuma Proving Ground
Yuma, AZ 85365-9101
(520) 328-2163

Commander: James M. Althouse, Col, EN
Technical Director: James L. Wymer

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.080	0.001	0.096	0.177
6.2	3.073	0.015	2.450	5.538
6.3	1.833	0.009	1.087	2.929
Subtotal (S&T)	**4.986**	**0.025**	**3.633**	**8.644**
6.4	3.691	0.018	2.757	6.466
6.5	4.153	0.021	3.131	7.305
6.6	4.966	0.025	1.214	6.205
6.7	0.006	0.000	0.005	0.011
Non-DOD	27.978	0.141	34.530	62.649
TOTAL RDT&E	**45.780**	**0.230**	**45.270**	**91.280**
Procurement	0.983	N/A	2.834	3.817
Operations & Maintenance	1.066	N/A	37.573	38.639
Other	1.819	N/A	2.578	4.397
TOTAL FUNDING	**49.648**	**0.230**	**88.255**	**138.133**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	31	31
CIVILIAN	0	104	496	600
TOTAL	**0**	**104**	**527**	**631**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	22.030	**REAL PROPERTY**	179.448
ADMIN	116.655	* NEW CAPITAL EQUIPMENT	7.383
OTHER	2074.770	**EQUIPMENT**	183.128
TOTAL	**2213.455**	* NEW SCIENTIFIC & ENG. EQUIP.	1.717
ACRES	**1008904**	* Subset of previous category.	

Institute of Surgical Research

FY2000 Abbreviated Functional Chart - Technical Organizations

Institute of Surgical Research

- **Laboratory Division**
  - -Pathology
  - -Comparative Medicine
  - -Microbiology
  - -Biochemistry
  - -Surgical Study
  - -Mechanical Trauma
  - -Extremity Trauma
- **Clinical Division**
  - -Burn Study
  - -Nursing Suc
  - -RT
  - -Internal Medicine
  - -Reconstruction and Rehabilitation
- **Support Division**
  - -Bioengineering
  - -Logistics
  - -Resource Mgt
  - -AV
  - -Library
  - -Medical Company

Institute of Surgical Research
Fort Sam Houston, TX 78234-6315
(210) 916-2720

Commander & Director: COL Cleon Goodwin
Deputy Commander: COL David Zolock

MISSION

Provide Combat Casualty Care medical solutions and products for injured soldiers by integrating laboratory and clinical research.

CURRENT IMPORTANT PROGRAMS

The FY00 USAISR's research focused on Combat Casualty Care research, providing the injured soldier a sustainable far forward life and limb survival advantage.

USAISR's primary thrust areas were: minimizing blood loss and optimizing fluid resuscitation; improve primary treatment of soft tissue and extremity injuries; treatments to prevent secondary damage after trauma injuries; and other battle and non-battle trauma injuries.

The major research projects were:

- Development of a hemostatic dressing to stop/reduce uncontrolled compressible hemorrhage from becoming life threatening. Uncontrolled hemorrhage is the major cause of death in injured soldiers.
- Development of an internal hemostatic agent to stop/reduce uncontrolled non-compressible hemorrhage (i.e., abdominal) from becoming life threatening.
- Development of improved resuscitative strategies prior to definitive treatment for injured soldiers before and during evacuation to minimize bleeding, promote tissue perfusion and optimize survival. Hemorrhagic shock remains the major cause of death on the battlefield.
- Development of methods of rapid wound treatments such as laser debridment and tissue welding/bonding.
- Diagnosis and/or treatment of wound infection.
- Development of flexible protective wound covers and splinting/pinning of bone and joints that allow stabilization and partial function of extremities and wounds.
- Identify technologies that determine severity of inhalation injuries as early as possible and develop appropriate treatments.
- Development of rapid imaging devices determining the extent of tissue injury (viability/blood flow).
- Determine the protective capability of new anti-mine footwear by evaluating the forces and injury patterns and developing a mathematical model for analysis of redesigns of the footwear and other body armor.

The USAISR has begun to refocus Combat Casualty Care research to support the Army transformation to the Objective Force. It is expected that casualties will be more dispersed on the battlefield and medical evacuation times increased. The research goal is to keep the casualties alive by increasing stabilization times and improve far forward treatments without decreasing combat capabilities. The

CURRENT IMPORTANT PROGRAMS

increased evacuation times require combat casualty care adaptations, new techniques and products that are less dependent on traditional rapid medical evacuation in order to prevent increased morbidity and mortality.

The Institute's Technology Transfer Program was very active with the completion of one Cooperative Research and Development Agreement, four Material Transfer Agreements, one Information Transfer Agreement, and thirteen new Invention Disclosures in FY00.

EQUIPMENT/FACILITIES

The USAISR's equipment inventory of basic and clinical research equipment is valued at over $18,114,000. The Institute consists of a 40 bed inpatient research unit of 50,300 square feet on the 4th floor of Brooke Army Medical Center and a clinical laboratory located in an adjacent 84,000 square foot research facility dedicated in FY96. Capabilities include: integrated clinical and laboratory research facilities and injured soldier test platforms; mass casualty burn care; aeromedical transport teams for multiple trauma victims with burns and other injuries; training in resuscitation and long-term injury care; a long-term computerized database to assess outcomes of severe injury; a nutrition and metabolic study program; comprehensive orthopedic surgery and extremity research staff and research program; ballistics research; state-of-the-art animal operating suites; an image analysis facility; biocontainment suite for studying the effects of hazardous materials; materials testing laboratory and tissue design and engineering capabilities; and the only research clinical evaluation/management facility for injured soldiers in the U.S. military.

Institute of Surgical Research
Fort Sam Houston, TX 78234-6315
(210) 916-2720

Commander & Director: COL Cleon Goodwin
Deputy Commander: COL David Zolock

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.053	N/A	N/A	0.053
6.1 Other	1.063	0.000	0.000	1.063
6.2	6.054	0.000	0.000	6.054
6.3	0.932	0.000	0.000	0.932
Subtotal (S&T)	**8.102**	**0.000**	**0.000**	**8.102**
6.4	0.120	0.000	0.000	0.120
6.5	0.000	0.000	0.000	0.000
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**8.222**	**0.000**	**0.000**	**8.222**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	8.827	N/A	0.000	8.827
TOTAL FUNDING	**17.049**	**0.000**	**0.000**	**17.049**

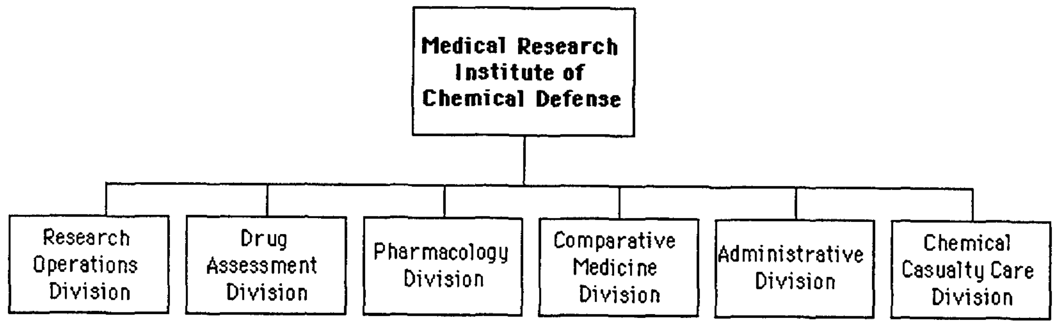
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	16	33	97	146
CIVILIAN	8	24	26	58
TOTAL	**24**	**57**	**123**	**204**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	73.850	**REAL PROPERTY**	17.191
ADMIN	11.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	50.300	**EQUIPMENT**	18.114
TOTAL	**135.150**	* NEW SCIENTIFIC & ENG. EQUIP.	1.649
ACRES	1	* Subset of previous category.	

Medical Research Institute of Chemical Defense

FY2000 Abbreviated Functional Chart - Technical Organizations



Medical Research Institute of Chemical Defense
Aberdeen Proving Ground, MD 21010-5400
(410) 436-3276
Commander: COL James A. Romano
Deputy Commander: COL Gennady E. Platoff

MISSION

The U.S. Army Medical Research Institute of Chemical Defense is the Department of Defense lead laboratory for development of medical countermeasures against chemical warfare (CW) agents and for training personnel in the medical management of chemical casualties. In order to establish a scientific and technical base from which to plan and formulate enhanced medical countermeasures to CW threats and develop improved prevention and treatment modalities for CW casualties, this mission includes: fundamental and applied research on mechanisms of action of CW threat agents, candidate pretreatment, treatment, and personal or skin decontamination compounds; test and evaluation of drugs, decontaminants, and medical equipment for the prevention, resuscitation, treatment, and management of chemical casualties. The Institute provides assistance in the integration of concepts and products from research development, test and evaluation mission activities into logistical, doctrine and organizational development and training systems as well as training of medical and non-medical personnel in the prevention and management of chemical casualties. The Institute also conducts research on medical defense against agents (neurotoxins) of biological origin.

CURRENT IMPORTANT PROGRAMS

In response to DA and DoD requirements, research programs at the USAMRICD emphasize preservation of combat effectiveness by timely provision of medical countermeasures to chemical warfare agents (CWA). These programs maintain technological capability to meet present requirements and to counter future CWA and neurotoxin threats, provide individual-level prevention and protection against these threats, and enhance the medical management of CW and neurotoxin casualties, enhancing survival and expediting and maximizing return to duty.

The MRICD conducts basic research, exploratory development, non-system development, and advanced development of medical countermeasures for CWA and neurotoxin agents; investigates the biomedical effects of CWA agents, neurotoxins, and candidate medical countermeasures to these threats; conducts safety and efficacy studies of candidate pretreatment and prophylactic countermeasures; develops analytical technologies for medical countermeasures, and performs advanced research into CWA and neurotoxin casualty care technology.

During the past year, milestone 0 objective (MS0) for DTO CB.22.MC demonstrated safety and efficacy of candidate countermeasures against vesicant injury was achieved on schedule. MS0 objective for DTO CB.21.J00 to develop mutant human butyrylcholinesterase and carboxylesterase enzymes for use as biological scavengers of organophosphorus nerve agents was met on schedule. Safety and efficacy objectives of STeP C (Science & Technology Plan) to develop an advanced anticonvulsant to serve as a component for the warfighter-buddy-use nerve agent antidote were also met. These studies demonstrated that midazolam is more effective in rapidly terminating on-going seizures, preventing their recurrence, protecting against nerve agent-induced seizure-related brain damage and is free of abuse potential. Midazolam was transitioned to MS1 on schedule and represents a significant improvement over the currently fielded anticonvulsant diazepam.

CURRENT IMPORTANT PROGRAMS

SERPACWA, a topical skin protectant (TSP) barrier cream developed to protect against penetration of CWA, was transitioned to MS3 for advanced development. For DTO.29.J00, an active-TSP capable of protecting against penetration of CWA and also detoxifying both vesicant and nerve agents was transitioned to MS0. An active-TSP provides signifcant improvement over the SERPACWA now in advanced development.

Under our Chemical Casualty Management STeP, fast screening confirmatory methods have been developed to verify CWA exposure. Enzyme-immobilized sponges and a methemoglobin monitor are undergoing evaluation for medical product development as well as strategies to reduce sulfur mustard-induced ocular injury and the application of laser debridement to increase healing of sulfur mustard-induced blisters.

The Institute continues to investigate the effects of chronic exposure to low doses of CWA agents. Institute scientists serve as technical consultants and monitor contracts and grants for Gulf War Illness and Neurotoxin research programs. A new Science & Technology Plan (STeP) to develop neuroprotectants for CWA-induced brain injury has been initiated. The search for cyanide countermeasures is presently in a STeW (Science & Tecnology Watch) category and a pathophysiology database has been developed on respiratory agents also currently in a technology watch status.

During FY00, 5 Medical Chemical & Biological Casualty (MCBC) courses on the Medical Management of Chemical Casualties were conducted for 487 students and 5 Field Chemical & Biological Casualty (FCBC) courses where 323 students were trained. In addition, the Institute provided a satellite broadcast course on Medical Response to Chemical Warfare and Terrorism. This broadcast was received in all 50 states and 9 countries. The broadcast was viewed by 3782 students who registered for CME credits.

The Institute maintained 4 Cooperative Research and Development Agreement (CRDA) and 28 Material Transfer Agreements (MTA) during FY00.

EQUIPMENT/FACILITIES

The Institute's facilities support chemical casualty care training, physiology, drug assessment, pathophysiology, pharmacology, analytical chemistry, neurotoxicology, veterinary surgery, chemical safety/surety, medical maintenance, information and resource management, logistics support, and quality assurance. A technical library with 6,000 books, 1,000 journal titles, and access to many databases is an integral part of our Institute. Video facility, computer facility and a 14,500 SF animal facility also supports our researchers. Radioisotope chemical antidote and biochemical analysis, histochemistry, behavioral testing, drug screening, pharmacokinetics, molecular modeling, liquid, gas, column and affinity chromatography, quantitative image enhancement/analysis, electrophoresis, spectroscopy, fluorometry and spectropolarimetry, GC mass spectrometry, nuclear magnetic resonant (NMR), multi-photon laser scanning microscope (MPLSM), electron spin resonance and peptide synthesis/sequencing, amino acid analysis, monoclonal hapten antibodies, electron, scanning and X-ray microscopy, cell cloning, and receptor analysis are also supported.

EQUIPMENT/FACILITIES

Major Facilities and Equipment:

Building E-3100: Main Medical Chemical Defense Research Laboratory and Administrative Building

Building E-3081: Unique to DoD. Contains a Chemical Surety Materiel Laboratory for Medical Chemical Defense Research

Building E-3156: Large Animal Holding/Chemical Research Facility

Building E-3244: Biotoxin Research Facility

Building E-3103/E-3106: Chemical Casualty Care Training Facility

Building E-3103/Classroom: Chemical portion of the Management of Chemical and Biological Casualties Course (6H-F26) is conducted here.

Building E-3101: Administrative Facility: Surety, Safety, Environment, and Contract Management

Hazardous Materiel Storage and 90-Day Hazardous Waste Sites: These sites meet stringent specifications which conform to the environmental requirements for the storage and disposition of chemicals and hazardous materials.

Building E-3105: Information Management Support Facility

Building E-3107: Equipment Turn-in Facility

Building E-3104: Environmentally Controlled Building for Electronic Equipment

Building E-2180: Equipment Storage and Turn-in Facility

Building E-3083: Equipment storage for Medical Chemical and Biological Casualties course

Building E-5826: Animal Care Equipment Storage Facility

Building E-3221: Toxic Waste Storage Facility

Direct Digital Control HVAC System: System provides constant control and 24-hour remote monitoring of chemical fume hoods in the Surety Area of building E-3081, controls HVAC throughout remainder of laboratories and administrative areas, and controls and remotely monitors all animal rooms in buildings E-3081, E-3100, E-3156, and E-3244.

Walk-in Coolers in Building E-3081, E-3100: Storage of chemicals used for research.

Chillers, Building E-3081: Installed in 1994 to meet EPA requirements. Each unit produces 350 tons of cooling using 123 refrigerant.

EQUIPMENT/FACILITIES
Chillers, Building E-3100: Installed in 1994 to meet EPA requirements. Each unit produces 350 tons of cooling using 123 refrigerant. Air Compressor: Required to supply laboratories with bench air for research. Chemical/Biological/Radiological (CBR) Filter Trains: Provided for all 77 chemical/biological hoods located in buildings E-3100, E-3081, and E-3244. Each CBR filter train consists of a housing unit containing prefilter, as well as the appropriate number and size of High Efficiency Particulate (HEPA) and High-Efficiency Gas-Phase Absorber (HEGA) filters. All filter trains are in support of the Chemical/Biological Defense Program and are in compliance with Environmental Protection Agency, State, and Federal Standards. Exterior Walk-in (adjacent Bldg E-3100): Storage of animal carcasses prior to incineration. Auxiliary Chillers (E-3100): Provides renovated laboratories with additional cooling to support electronic equipment. Decontamination Showers Required to conduct research in accordance with regulations. Building E-3156/Associated Animal Pens and rooms: Quarantine area for newly arrived large animal species. Required for the care of animals used in research. House Water Distillation System (Bldgs E-3100, E3081, E-3244): This central system feeds water to satellite polishing systems in the individual laboratories. Pure laboratory water is needed in virtually all segments of laboratory research. High-purity water is used for reagent buffers and sensitive instrumental analyses such as High Pressure Liquid Chromatograph, Gas Chromatograph/Mass Spectrometer, as well as inwashing and/or preparing biological solutions such as media for tissue culture. Hazardous Materiel and 90-Day Hazardous Waste Sites: These sites meet stringent specifications which conform to the environmental requirements for the storage and disposition of chemicals and hazardous materials. Emergency Generator (Bldg E-3100): Provides emergency power for lighting, freezers, incubators, and other specialized equipment which must remain operational. Administrative and Laboratory Emergency Generator (Bldg E-3081): Provides emergency power for lighting, freezers, incubators, and other equipment which must remain operational. Surety Area Back-up Generator (Bldg E-3081): Supplies emergency power to the entire chemical surety wing to include all fume hoods, heating, ventilation and air conditioning systems, and electrical systems. Surety Area Holding Tanks (Bldg E-3081): Consists of two 10,000 gallon tanks which hold all waste water generated in the surety wing. This ensures that chemical spills will not escape into the sanitary sewer.

Medical Research Institute of Chemical Defense
Aberdeen Proving Ground, MD 21010-5400
(410) 436-3276
Commander: COL James A. Romano
Deputy Commander: COL Gennady E. Platoff

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.048	N/A	N/A	0.048
6.1 Other	5.645	0.000	1.635	7.280
6.2	9.844	0.000	1.416	11.260
6.3	3.925	0.000	4.704	8.629
Subtotal (S&T)	**19.462**	**0.000**	**7.755**	**27.217**
6.4	0.333	0.000	0.000	0.333
6.5	0.014	0.000	0.000	0.014
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**19.809**	**0.000**	**7.755**	**27.564**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	2.223	N/A	0.000	2.223
Other	3.730	N/A	0.000	3.730
TOTAL FUNDING	**25.762**	**0.000**	**7.755**	**33.517**

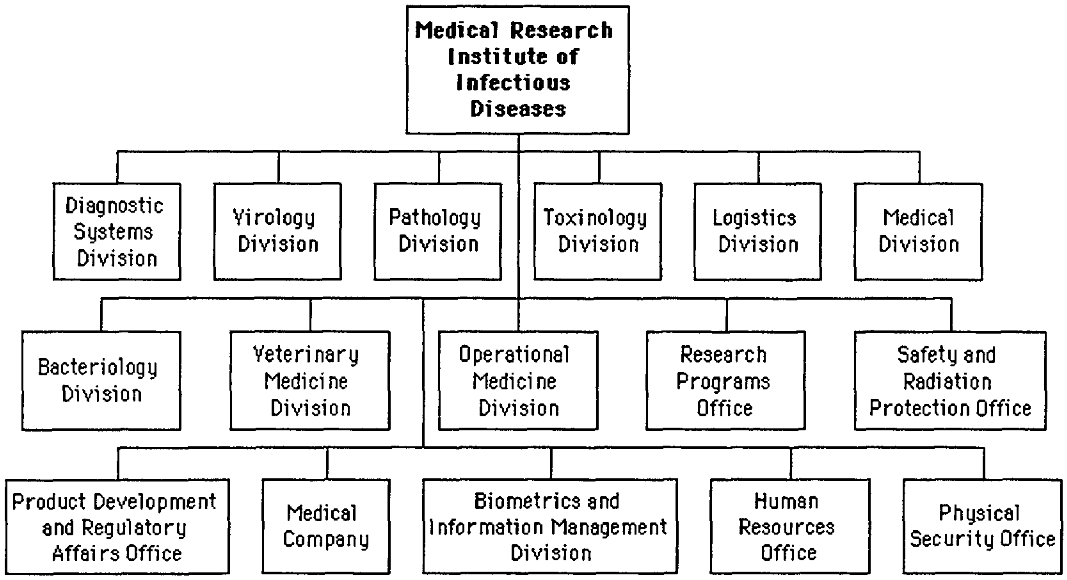
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	15	9	30	54
CIVILIAN	28	29	83	140
TOTAL	**43**	**38**	**113**	**194**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	37.419	**REAL PROPERTY**	23.400
ADMIN	38.433	* NEW CAPITAL EQUIPMENT	0.000
OTHER	125.024	**EQUIPMENT**	31.900
TOTAL	**200.876**	* NEW SCIENTIFIC & ENG. EQUIP.	3.100
ACRES	**30**	* Subset of previous category.	

Medical Research Institute of Infectious Diseases

FY2000 Abbreviated Functional Chart - Technical Organizations



Medical Research Institute of Infectious Diseases
Fort Detrick, MD 21702-5011
(301) 619-2833

Commander: COL Edward M. Eitzen
Deputy Commander: LTC George W. Korch, Jr.

MISSION

USAMRIID's mission is to conduct research to develop strategies, products, information and training for medical defense against biological warfare threats and against naturally occurring infectious agents of military importance that require special containment. Medical countermeasures developed to protect military personnel against biological attack include vaccines, therapeutic drugs, diagnostic capabilities, and various medical management procedures. These products are intended to eliminate or minimize the effects of disease and preserve fighting strength. The Institute is the lead research laboratory in the Medical Biological Defense Research Program and participates in crucial aspects of the Infectious Disease Research Program. The Institute serves a key role in national defense and in infectious disease research as the largest biological containment laboratory in the Department of Defense for the study of hazardous diseases. In addition, USAMRIID provides critical and timely training in medical management of biological casualties to both military and civilian healthcare providers. USAMRIID provides technical expertise and consultation to other DoD and civilian government agencies as a member of several interagency biological counterterrorism advisory groups. As a world-renowned resource, USAMRIID serves as the reference laboratory for DoD and other government agencies for identification of biological agents and diagnosis of diseases caused by them, and is also a reference center for the U.S. Centers for Disease Control and Prevention and the World Health Organization.

CURRENT IMPORTANT PROGRAMS

The development of medical countermeasures, to include vaccine and therapeutic drug candidates and diagnostic assays for biological warfare threats, continues to be the highest mission priority for USAMRIID. Significant progress has continued within the Medical Biological Defense Research Program including Milestone I transition of candidate products for an infectious clone vaccine for Venezuelan equine encephalitis (serotype 1 A/B) and for recombinant vaccines against several sterotypes of botulinum neurotoxins to the Joint Vaccine Acquisition Program (JVAP). Pilot lots of vaccines for plague, anthrax and staphylococcal enterotoxin B threats have been programmed or produced under current Good Manufacturing Process (cGMP). An approach for a vaccine against one of the filovirus threats was successfully demonstrated in a non-human primate model. A number of new research efforts were initiated under the auspices of a Program Decision Memorandum for the development of effective therapeutics against SEB and botulinum toxins for either post-exposure treatment of casualties or pre-exposure prophylaxis. Diagnostic devices and assays that provide highly sensitive and specific readout for a wide range of biological threats have been developed for nucleic acid and immunological targets. Many of these diagnostic efforts were conducted with CRDA partners that provide highly novel technologies to enhance the USAMRIID program. Evaluation of these assays is enhanced through established relationship with the 520th Theater Army Medical Laboratory. Extensive in vitro and in vivo testing of antiviral compounds for therapeutic effect against orthopox viruses were conducted by USAMRIID scientists both in-house for surrogate viruses such as monkeypox, vaccinia, cowpox, and against variola itself at the BL-4 facility at the Centers for Disease Control and Prevention. USAMRIID also supports the Medical Infectious Disease Research Program by conducting research on highly infectious endemic disease threats, and is currently developing a candidate hantavirus vaccine for

CURRENT IMPORTANT PROGRAMS

this program. USAMRIID continued training of military healthcare providers in the Medical Management of Biological Casualties Course in collaboration with the Centers for Disease Control and Prevention. The institute is recognized as an important national resource for supporting biological counterterrorism and assists other agencies in this area. USAMRIID researchers actively support the DoD Cooperative Threat Reduction Program, participating as collaborators with Russian scientists in several mission-related research projects.

EQUIPMENT/FACILITIES

Three buildings provide 347,000 square feet with approximately 15% of the laboratory space capable of operations at biosafety level 3 and approximately 3% capable of operations at biosafety level 4 (maximum containment). These containment laboratories are a unique national and international resource for the safe study of high hazard disease agents; the biosafety level 4 laboratories are the only such laboratories within the DoD. The Medical Entomology BSL-3 suite at USAMRIID is also completely unique in the U.S. and has been invaluable over the recent past in providing critical entomological support and evaluation of the vector competency. Other unique facilities include: a 16-bed clinical research ward, high containment patient care facility (the only such facility in the U.S.) and support functions, contained dynamic aerosol laboratory exposure systems, cell culture and hybridoma laboratory, and electron microscopy equipment. The laboratory facilities also include a farm for the care and housing of large animals used in research. The laboratory animal facilities are accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care, International. The laboratories contain state-of-the-art equipment to support studies in molecular biology, protein chemistry, gene sequencing and analysis, microbiology, virology, and biochemistry. In addition, USAMRIID has special mobile patient containment equipment designed to allow for the safe transport and medical care of a patient with a highly hazardous disease.

Medical Research Institute of Infectious Diseases
Fort Detrick, MD 21702-5011 Commander: COL Edward M. Eitzen
(301) 619-2833 Deputy Commander: LTC George W. Korch, Jr.

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	1.099	N/A	N/A	1.099
6.1 Other	16.593	0.298	0.000	16.891
6.2	13.753	0.539	0.000	14.292
6.3	10.406	0.149	0.000	10.555
Subtotal (S&T)	**41.851**	**0.986**	**0.000**	**42.837**
6.4	0.000	0.000	0.000	0.000
6.5	0.016	0.000	0.000	0.016
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**41.867**	**0.986**	**0.000**	**42.853**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.417	N/A	0.000	0.417
Other	17.739	N/A	0.000	17.739
TOTAL FUNDING	**60.023**	**0.986**	**0.000**	**61.009**

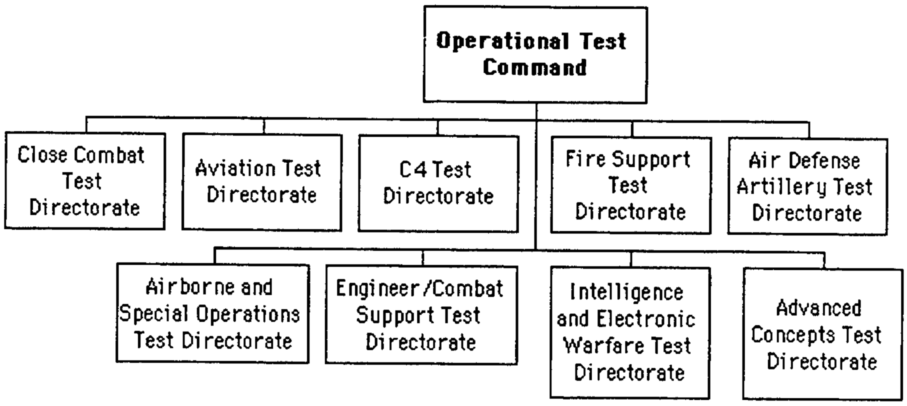
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	
TYPE	DOCTORATES	OTHER		END STRENGTH
MILITARY	44	32	134	210
CIVILIAN	51	62	120	233
TOTAL	**95**	**94**	**254**	**443**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	334.110	**REAL PROPERTY**	24.900
ADMIN	8.125	* NEW CAPITAL EQUIPMENT	0.300
OTHER	20.317	**EQUIPMENT**	43.500
TOTAL	**362.552**	* NEW SCIENTIFIC & ENG. EQUIP.	3.800
ACRES	**169**	* Subset of previous category.	

Operational Test Command

FY2000 Abbreviated Functional Chart - Technical Organizations



Operational Test Command
Fort Hood, TX 76544-5068
254-288-1304

Commander: Fred D. Robinson, Jr.
Technical Director: Harold C. Pasini, Jr.

MISSION

Support the Army materiel acquisition and force development processes by executing the User Testing Program and conducting operational testing to support force development.

CURRENT IMPORTANT PROGRAMS

- Force XX1 Battle Command Brigade and Below (FBCB2)
- Extended System Integrated Test - M270A1
- Integrated System Control (ISYSCON)
- Guardrail/Common Sensor System II (GRCS)
- Heavy Assault Bridge (HAB)
- Warfighter Information Network Terrestrial Transport (WIN-T)
- Bradley Fighting Vehicle System (BFVS)
- Special Operations Forces Tactical Assured Connectivity System (SOFTACS)
- Close Combat Tactical Trainer (CCTT)
- Long Range Sniper Rifle (LRSR)
- Forward Repair System (FRS)

EQUIPMENT/FACILITIES

Position location, high angle modular integrated target, video, data acquisition and reduction, thermal imaging, fiber optics and video multiplexer/demultiplexer, range timing, microwave, environmental measurement and survey.

Operational Test Command
Fort Hood, TX 76544-5068
254-288-1304

Commander: Fred D. Robinson, Jr.
Technical Director: Harold C. Pasini, Jr.

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	0.000	0.000	0.000	0.000
6.3	0.000	0.000	0.000	0.000
Subtotal (S&T)	**0.000**	**0.000**	**0.000**	**0.000**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	0.000	0.000
6.6	86.200	0.000	0.000	86.200
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**86.200**	**0.000**	**0.000**	**86.200**
Procurement	1.300	N/A	0.000	1.300
Operations & Maintenance	35.400	N/A	0.000	35.400
Other	0.000	N/A	0.000	0.000
TOTAL FUNDING	**122.900**	**0.000**	**0.000**	**122.900**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	
TYPE	DOCTORATES	OTHER		END STRENGTH
MILITARY	0	27	254	281
CIVILIAN	1	92	458	551
TOTAL	**1**	**119**	**712**	**832**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	0.000	**REAL PROPERTY**	33.100
ADMIN	459.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	214.000	**EQUIPMENT**	0.000
TOTAL	**673.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**22**	* Subset of previous category.	

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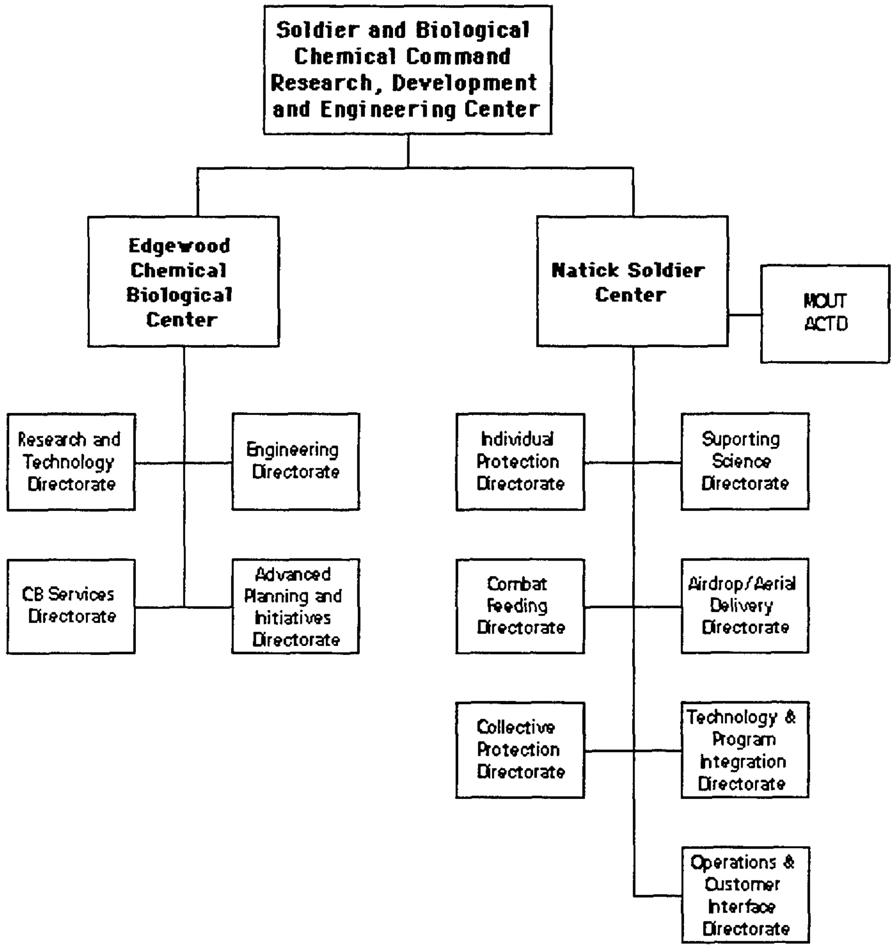
Soldier and Biological Chemical Command RDEC

FY2000 Abbreviated Functional Chart - Technical Organizations



Soldier and Biological Chemical Command RDEC
Aberdeen Proving Ground, MD 21010
(410) 436-5501
Technical Director, RDEC: Jim Zarzycki
Technical Director, NSC: Philip Brandler

MISSION

SBCCOM RDEC: To perform, conduct, and manage basic and applied research, development and engineering for all soldier and related support systems; chemical and biological defense non-medical systems; and assigned equipment. Support Program Executive Officers, Program Managers or other Department of Defense elements having centralized management responsibility for specific weapon systems or items.

Natick Soldier Center's (NSC) mission is to maximize the warrior survivability, sustainability, mobility, combat effectiveness and quality of life through basic and applied research, technology development and demonstration, and engineering of rations, food service equipment, combat clothing and individual equipment, shelters, airdrop systems and organizational equipment. Provide the necessary RD&E to integrate the technologies for combat-essential elements of command and control, survivability, lethality, sustainability and mobility into the soldier system. Perform a similar function to integrate technologies for soldier support systems and for warrior support systems for other services and agencies.

Edgewood Chemical Biological Center's (ECBC) mission is to provide U.S. Forces with the capability to survive and sustain mission operations on a 21st Century digitized battlefield through application of nuclear, biological, and chemical (NBC) defense, obscuration, flame, non-lethal weapons science and technology, engineering, products and life cycle services. Leverage core capabilities by providing products and services to vital national programs such as Weapons of Mass Destruction, Domestic Preparedness, chemical treaty verification and environmental remediation in partnership with government, academia and private organizations.

CURRENT IMPORTANT PROGRAMS

The Natick Soldier Center (NSC) is developing integrated systems and technologies for the future warrior that provide enhancement of combat performance in the areas of lethality, survivability, command and control, mobility and sustainment. Particular emphasis is placed on minimizing overall soldier system weight, cost and power demands while ensuring enhanced fightability and human factors. The Future Warrior Technology Integration STO and the Lightweight Soldier STO are both contributing to Science & Technology advancements. In FY00 a Dead Reckoning Module (DRM) was provided to Land Warrior for integration into the LW version 0.6 system in support of the Joint Contingency Force (JCF) Advanced Warfighting Experiment (AWE) held in September. Additionally, a preliminary report on Integrated Navigation (INAV) was delivered to PM Soldier Systems, extensive trade studies were conducted to determine the best methods for integrating Combat Identification (CID) into LW v.1.0, a Land Warrior - Combat Identification - Tactical Engagement Simulation report was published documenting the results and recommendations, and a far-reaching System Voice Control (SVC) Trade Study and Product Analysis was conducted with a detailed technology report produced.

This year marks a unique opportunity for the Natick Soldier Center to address the intent of the Army Vision relative to the Objective Force. At the very highest levels of the Army the importance of the Soldier has been noted as key to achieving the vision for the Objective Force. Much of the activity and

CURRENT IMPORTANT PROGRAMS

increased Army resource investment to date has revolved around FCS. However, the CSA and the VCSA have plainly stated that the Objective Force is Soldier-centric.

The **Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD)** program completed its experimentation phase in Sep 00 and is currently transitioning to the residual phase/Extended User Evaluation. The program has evaluated 32 requirements in the areas of C4ISR, Lethality, Force Protection, and Mobility. Approximately 25 successfully evaluated technologies are being provided and supported by the program for 2 years to the Army's 10th MTN Div and USMC's 2nd Marine Division. The residual operational capability provided will be a series of advanced systems or components forming a functionally integrated MOUT ACTD "System of Systems." Some of the most promising technologies, including a Rifle Launched Entry Munition (RLEM), Blunt Trauma Training Ammunition and Mechanical Wall Breacher have already been transitioned to Army and USMC acquisition programs, and efforts are ongoing to transition four additional capabilities into acquisition programs, including explosive wall breach, rapid mapping, virtual mission planning, and man-portable ladders. Further, based on DUSD (AS&C) guidance, the MOUT ACTD program is executing a one-year extension to experimentation activities to focus on requirements that were unable to be evaluated during the program's regularly scheduled experimentation due to insufficient technology maturity at the time. Due to recent technology advances, FY01 work will include evaluation of thru-wall sensor, stand-off wall breach, intelligence collection/dissemination, organic UAV-based rapid mapping, and soldier monitoring/position-location technologies.

Within the **Individual Protection Directorate**, the Warrior's survivability is maximized through the development of technologies and components that provide individual protection from ballistic, percutaneous chemical and biological, environmental, flame, surveillance, and directed energy threats. In the ballistics area, requirements for assessment criteria and test methodology to determine ballistic casualty reduction potential of emerging technology were defined and novel materials/systems demonstrating concepts to increase protection and reduce weight of personnel armor for both head and torso against emerging ballistic threats were evaluated. The CB area established that Selectively Permeable Membrane (SPM) technology is 50% lighter weight than any currently fielded garment while providing equivalent or better protection, established the effectiveness and durability of SPM garments, and demonstrated the effectiveness of integrated closure systems which show the closure systems are acceptable to users but could be more flexible. Test methodologies for flame resistant textile material systems for soldier protection were established in the multifunctional materials area. The U.S. Marine Corps (USMC) provided funds to research, develop and procure clothing and individual protective equipment during FY00. Efforts include the Army and Marine Corps acceptance of a new Infantry Combat Boot (reduced weight and increased performance), the Full Spectrum Battlefield Equipment (FSBE)--extremely quick development--concept to fielding in 13 weeks and the Marine Corps on-going effort to develop a combat utility uniform to replace the current BDU. Plans continue with the Bureau of Engraving and Printing (BEP) to develop and expand their operation in the area of fiber research at the NSC.

One Cooperative Research and Development Agreement (CRDA) supports ballistic protective fibers produced through genetic engineering techniques for ballistic impact applications. Nine other CRDAs are in place to support the RDT&E of new materials and configurations for protective clothing and individual equipment systems. Another CRDA supports research into the development of synthetic fibers from recycled polyester (PET) bottles. One new CRDA was signed in FY00 that leverages the development of revolutionary fibers and materials for chemical and biological protection in individual protective clothing and equipment.

CURRENT IMPORTANT PROGRAMS

The **Airdrop/Aerial Delivery Directorate** is developing technologies for airdrop equipment, personnel, supplies and equipment in support of mass assaults, re-supply, and humanitarian relief. Airdrop/Aerial Delivery S&T efforts focus on cargo/re-supply airdrop to deliver more precise weapons and munitions, reduce aircraft and payload vulnerability, improve load survivability, and improve drop zone dispersion and reassembly time. Two approaches are used, development of low altitude (500 ft) airdrop technologies for precision aerial delivery of heavy cargo and development of technologies for precision guided, high-altitude, standoff delivery capabilities. NSC has been investigating and developing novel airdrop platforms (e.g., parafoil, semi-rigid wing) with autonomously guided (GPS guidance/navigation), high altitude (25,000 feet), offset (25 miles) delivery capabilities. In the personnel airdrop area, efforts are focused on reducing parachutist injury due to high velocity landing, enhanced maneuverability and extended gliding capabilities, and parachute design optimization to achieve lower cost, lower volume parachute designs.

One CRDA supports airdrop R&D in the area of cushioning airdrop payloads by using gas-injected airbag technology. Another CRDA is using a phased approach to explore the flight control characteristics of high glide, semi-rigid wings, and to assess the feasibility of increasing range by use of a glide augmentation system.

The **Collective Protection Directorate (CPD)** is developing advanced shelters and shelter systems that provide new capabilities or enhancements, such as high pressure, airbeam-supported maintenance shelters (lighter weight, less cube, quick erection); command posts; and collective protection medical treatment facilities and hospitals. Two new textile technologies were demonstrated and prototyped for 85' wide span airbeams used in rapidly deployable maintenance shelters. CPD showcased a 30 Soldier Bare Base C2 Module (C2-MOD) command center at the FORSCOM Commander's Conference. CP designed and prototyped a 10 soldier sub-module of the C2-MOD, the Early Entry LSE System (EELS). Both systems support AMC LSE teams. The Large Area Maintenance Shelter (LAMS) team supported missions in Kosovo, Bosnia, Hungary, Macedonia, Goose Creek, SC and RMA, CO. CPD established a Partnering with Field Unit relationship with the 201st Military Intelligence Brigade to develop a DISE (Deployable Intelligence Support Element) and ASC (Analysis Control Element) Command Center using C2-MOD components.

The **DoD Combat Feeding Directorate** is developing a Joint Service family of performance-enhancing combat rations (special-purpose and standard individual/group) and modularized field feeding equipment, such as the Rapid Deployment Kitchen, to support the full spectrum of tactical scenarios.

18 CRDAs support combat rations and field feeding R&D with innovative methods to provide irradiation; preservation of foods; improved capability for preparing special microencapsulated performance-enhancing nutrients; shelf-stable, eat-out-of-hand ration components; candidate replacements for the hydrogen producing Flameless Ration Heater (FRH); research for the production of fresh-like fruit and vegetables with reduced weight and volume; interactive food packaging; development, test and evaluation of concentrated fruit juices; and another CRDA in effect supports the development of biodegradable plastics from milk fat. Four of these CRDAs were signed in FY00.

Three master CRDAs are in place with major commercial R&D companies covering a wide range of commodity areas, with each focusing on specific mission needs. One CRDA supports advanced protective clothing, food formulations/services, collective protective technologies, and organizational

CURRENT IMPORTANT PROGRAMS

equipment. Another supports ballistics protection, CB protection and associated equipment, and environmentally protective clothing and equipment. The third involves a major software developer in the Army development of high resolution terrain visualization for assessment of Natick systems.

The **Supporting Science Directorate** is evolving and exploiting research in materials science, human sciences, operations research/systems analysis (e.g., SMART). Its broad multi-disciplinary research encompasses diversified scientific and engineering disciplines (e.g., food chemistry, polymer chemistry, physics, chemical engineering, applied mathematics, mechanical engineering, engineering and experimental psychology, food acceptance, nutrition, microbiology, biology, biotechnology, and modeling and simulation). Some unique programs involve (a) bioengineering technology and nanotechnology that are breaking new ground to provide the technology for new advanced materials; (b) physical anthropology that is providing capabilities to address work station design, clothing sizing and tariffing, and other issues involving the effects of human sizes and shapes on the effective utilization of systems; and (c) biomechanics that, in addition to providing basic physical-mechanical design parameters for soldier equipment, in combination with physical anthropometry is also furnishing trade-off information between coverage or fit and mobility or maneuverability for soldier items such as advanced body armor.

National Protection Center (NPC) - The NPC is a collaborative pilot program between SBCCOM/NSC, NASA Ames Research Center and the National Institute of Justice (NIJ) focused on the personal protection and integrated systems for personnel engaged in high-risk occupations (military and civilian). The government consortia partners with academia and industry as a national focal point for R&D for advanced protective clothing, equipment and integrated individual protection systems for military, public safety and space users. It provides a forum for leveraging advanced technology/programs and testing and evaluation of systems that protect against a full spectrum of threats: ballistic, explosives, chemical/biological/radiological, flame, thermal, hazardous chemicals/pollutants, environmental, in single and multiple threat environments.

The goal of the NPC is to establish full operational capability based on its success in improving communication across multiple disciplines and programs. It will focus on expediting leveraged R&D programs, consolidate requirements, promote technology integration and national forums for equipment standardization, and maximize utilization of both personnel and financial resources.

To date, CRADA's have been signed with state and local agencies such as the Massachusetts Executive Office of Public Safety, and the Boston Emergency Management Agency (BEMA), and with all five campuses of the University of Massachusetts. An Interagency Agreement has been signed with NASA and a Natick Site office for the Department of Justice Office of Law Enforcement Technology Commercialization (OLETC) has been established. The first Technology Working Group (TWG) meeting was held and focused on Personnel Status Monitoring efforts across government, industry and academia.

Edgewood Chemical Biological Center

Contamination Avoidance. Includes NBC reconnaissance, detection, identification, warning, and reporting. Earliest possible warning is fundamental in avoiding chemical and biological agent contamination. The program aggressively pursues technology advances in chemical and biological stand-off detection, remote/early warning detection, sensor miniaturization, and improved detection

CURRENT IMPORTANT PROGRAMS

sensitivity. Systems include: M22 Automatic Chemical Agent Detector Alarm (ACADA), M21 Automatic Chemical Agent Alarm, Biological Integrated Detection System (BIDS), Improved Chemical Agent Monitor (ICAM), M93 Fox NBC Reconnaissance System, Joint Services Lightweight Standoff Chemical Agent Detector (JSLSCAD), Joint Warning and Reporting Network (JWARN).

Decontamination. In the event that contamination cannot be avoided, personnel and equipment must be decontaminated in order to reduce and/or eliminate hazards after chemical and biological agent employment. Decontamination systems provide the force a regeneration capability for units that become contaminated. Modular decontamination systems have been developed to provide decontamination units with the capability to tailor their equipment to support specific missions. The program is pursuing technology advances in sorbents, coatings, and physical removal, which will reduce logistics burden, manpower requirements, and lost operational capability to tailor their equipment to support specific missions. The program is pursuing technology advances in sorbents, coatings, and physical removal, which will reduce logistics burden, manpower requirements, and lost operational capability associated with decontamination operations. Systems include: Modular Decontamination System, Sorbent Decontamination System.

Individual and Collective Protection. In the event that early warning is not possible or units are forced to occupy or traverse CB contaminated environments, individual and collective protection systems provide the warfighter life sustaining and continued operational capabilities. Individual protection includes protective masks, suits, boots and gloves. Collective protection equipment includes standalone shelters and integrated systems that provide a contamination-free, environmentally-controlled surroundings for soldiers to perform their missions. Collective protection (i.e., overpressure) can be applied to mobile and fixed command posts, medical facilities, rest and relief shelters, buildings/fixed sites, vehicles, aircraft, and ships. The program is pursuing technology advances that provide an individual with improved vision and voice capabilities, increased protection levels and reduced heat stress over current individual protective equipment. Also the program pursues technology advances that improve generic CB protective filters and fans and advances that reduce weight, volume, cost, logistics and manpower requirements. Systems include: M40 Chemical/Biological Protective Field Mask, Joint Service General Purpose Mask (JSGPM), M45 Aircrew Chemical-Biological Mask, M43 Chemical-Biological, Aircraft Mask, M41 Protection Assessment Test System (PATS).

Smoke/Obscurants. In a matrixed partnership with the Product Manager, the program covers all technical disciplines in all phases (tech base, development, production, and sustainment) of the acquisition life cycle necessary to provide Army forces with a state-of-the-art battlefield obscurant capability. These programs provide products/systems that focus on two key elements, specifically, large area smoke, and rapid obscuration smoke. Large area smoke provides both visual and infrared obscuration capability to our forces, to include both light and heavy maneuver units. Rapid obscuration also provides both visual and infrared obscuration capabilities, but is designed primarily for self-protection of individual maneuver vehicles. The program includes interface with the other services, actively seeks joint development possibilities and encompasses international cooperative development, to include foreign military sales. Systems include: M56 Smoke Generator System, M58 Smoke Generator System, M157A2 Smoke Generator Set & M1059/M1059A3 Smoke Generator Carrier, Lightweight Vehicle Obscuration Smoke System (LVOSS).

Domestic Preparedness. The initiative was formed under FY 1997 Defense Authorization Bill (Public Law 104-201, September 23, 1996), commonly called the Nunn-Lugar-Domenici legislation. The bill

CURRENT IMPORTANT PROGRAMS

provides funding for the Department of Defense (DoD) to enhance the capability of federal, state and local emergency responders in incidents involving nuclear, biological and chemical terrorism. ECBC is the lead DoD agency charged with enhancing existing metropolitan response capabilities to include nuclear, chemical and biological incidents. Six separate training courses have been developed to accomplish this task: Awareness, Operations, Technician-HAZMAT, Technician-Emergency Medical Service, Hospital Provider and Incident Command. Program training is arranged by a federal interagency team comprised of representatives from the Federal Bureau of Investigation, Federal Emergency Management Agency, Department of Energy, Environmental Protection Agency, Public Health Service and Department of Defense. Initially, team representatives explain their role and capabilities to the city. The city then schedules training and determines which classes are best suited for the community's emergency responders. Cities are trained in a team approach, which combines subject matter experts with experienced emergency responders. This special training team dynamic combines DoD chemical and biological expertise with experienced, professional emergency responders. An interagency tabletop exercise provides opportunities for emergency responders and leaders to demonstrate practical decision-making applications of the classroom training. The courses are designed to "train-the-trainer," supplying emergency responders with the knowledge and experience needed to conduct their own training program with specialized nuclear, chemical and biological training materials.

Force Protection. Chemical and biological support to Joint Staff (J34) vulnerability assessments at select DoD installations. Standards/guidelines/tools developed to prepare installations against Weapons of Mass Destruction (WMD) threat. WMD training provided.

Installation Protection. The program is an integrated solution to prepare U.S. CONUS power projection sites to prepare and protect against a CB attack (particularly during a deployment), to assure continuity of operations by quickly restoring vital projection missions, and to safely mitigate the impact of such attacks. The program will include assistance in CB planning, training, exercising, identifying CB defense equipment and facility protection requirements, and providing other technical assistance as required. The program will also procure CB defense test equipment identified during the planning phase which is required to prepare, protect and restore operations following a CB attack.

Operations and Remediation/Restoration. Environmental monitoring, analysis, demolition and protection.

Chemical and Biological Arms Control and treaty assistance. Compliance and verification programs.

Chemical and Biological Counterterrorism. RDT&E for the Technical Support Working Group.

Forensic Services. The Forensic Analytical Center offers customers high quality analysis of materials relating to chemical and/or biological warfare, backed by its internationally recognized ISO 9001 registration and ISO Guide 25 accreditation. Current customers include all the other branches of the Armed Forces, the Defense Threat Reduction Agency, the Chemical Biological Rapid Response Team, the Federal Bureau of Investigation Laboratory Division, the Federal Aviation Administration Technical Center, the Program Manager for Chemical Demilitarization, and the Cooperative Threat Reduction program.

EQUIPMENT/FACILITIES

The Natick Soldier Center has the facilities and capabilities to perform all physical wet and dry performance testing, and visual and instrumental color analysis on textile materials. Other unique capabilities include the Climatic Chambers, Rain-room Facility, Camouflage Analysis and Demonstration Facility, the Shade Room and the Microscopy Laboratory.

The Doriot Climatic Chambers are used in support of both SBCCOM and the U.S. Army Research Institute of Environmental Medicine (USARIEM) programs. The support includes testing soldier endurance at environmental extremes, evaluating developmental items prior to procurement, and conducting extensive human physiological research.

There are two large wind tunnels and two smaller conditioning rooms for testing new clothing items, shelters, airdrop equipment, and other items developed by the U.S. Army and Navy. USARIEM conducts human physiological research. Scientists conducting research in the building strive to maximize the survival and improve sustaining and supporting for our armed forces on future battlefields that could be located in any climate on earth. Each chamber is designed for human (they can support prolonged live-in studies) and equipment research with a test monitoring area outside each chamber. The chambers can: reproduce temperature ranges from -70° to +165 ° Fahrenheit with a +/- 1° Fahrenheit accuracy; relative humidity can range from 10 to 90 percent; rainfall can be produced at a rate of up to 4 inches per hour; and wind speeds can be generated from 2 to 40 miles per hour. These climatic conditions can be changed rapidly. Test equipment includes two built-in 5-person treadmills per chamber. These treadmills are capable of testing at speeds up to 15 MPH with inclines of up to 12%. The two conditioning rooms are for testing of equipment and clothing.

Laser Systems can produce all wavelengths necessary to test the performance of eyewear. A picosecond laser can be used for probing the optical properties of developmental materials by utilizing such techniques as degenerate four-wave mixing, z-scan and time resolved measurements. A 2.5 kW CO_2 laser is also available for thermal studies. NSC has the capabilities to evaluate laser eye-protection systems at numerous wavelengths, output powers and pulse widths. Other unique capabilities include ballistic, haze and weatherometer testing of laser and ballistic eye protection systems, as well as a complete thermal data acquisition and analysis system. NSC can also evaluate the physical and optical properties of developmental materials and verify end-item compliance with American National Standards Institute (ANSI) or military performance specifications.

Thermal Transfer Measurements through laboratory materials and clothing systems are made with our CO_2 laser and instrumented manikin. The data are used as input to a computer code, which calculates skin burn severity.

Environmental Corrosion Chamber allows for accelerated salt fog corrosion testing per MIL-STD-810 on items as large as 21" X 21" X 28".

Water Jet Cutting Equipment allows for the most precise and accurate cut possible on all materials. Water Jet cutting is excellent for cutting the most complex shapes, and flexible enough to use the most fragile of materials.

Prototype, Fabrication and Testing Facility employs highly qualified Model Makers (metal, wood, plastics), Instrument Makers, Machinists, Plastic Mold Makers, Sheet Metal men, Welders and

EQUIPMENT/FACILITIES

Electricians to fabricate and aid in the design and construction of projects. A computerized Turning Center assures that the material being machined is precise and accurate.

Rapid Prototyping. The Rapid Prototype System will produce precise solid 3-D objects up to 32"L X 22"W X 20"H of unlimited geometric complexities from 3-D CAD data that is in a Stereolithography (STL) format. Larger parts can be produced in sections, then fastened together. Objects of unlimited geometric complexity can be produced with tolerances of +0.002 inches.

The Textile Pilot Plant has the full capability to dye, print and apply functional finishes to textile materials. It can produce printed camouflage patterns based on standard and experimental designs. The plant provides development work in support of combat clothing and textile based individual equipment, e.g. backpacks and tentage. The facility is used to support the needs of the U.S. Navy, U.S. Marine Corps, U.S. Air Force and Special Forces.

The Raincourt Facility is approximately 40 feet by 40 feet, and can simulate naturally occurring rainfall at 0.2, 1.0 and 3.0 inches per hour. This information is used to support the development of field items that will keep the soldiers dry and comfortable during military operations in a wet environment. It is used to screen candidate water repellent treatments and textile materials, evaluate seams for water resistance, and identify reason for field failures.

Tentage Prototype Shop. Tentage Prototype Shop Design and prototyping of fabric structures interface kits and accessories using heat sealing, ultrasonic welding, radio frequency welding, sewing, etc.

The Camouflage Evaluation Facility (CEF) provides the ability to evaluate current and experimental camouflage patterns year round. The settings consist of scenes that serve as a controlled background for evaluating camouflage.

Four environmental settings are represented: desert, woodland, urban and arctic. Live plants and desert sand add realism for in-house measurements. The facility is equipped with special lighting that can be adjusted to simulate different levels of moonlit and moonless skies. The CEF offers a baseline that everything in the facility can be measured and compared against on a "standardized" basis. Unlike outdoor test sites, which are never constant and continually changing, in-house measurements improve data reliability and validity.

Design and Pattern Grading Facility designs and develops Ballistic Protection, Chemical Protection, Combat and Dress Clothing, fabricates representative prototypes, and furnishes computerized graded patterns. The facility has the various sewing machines, presses, fusing machines, and ultrasonic machine necessary to accomplish this mission.

Utilization of an Apparel Design System provides a nearly endless variety of menu driven software choices for pattern manipulation, grading, marking, plotting and cutting. For pattern output the system provides patterns utilizing a plotter or fabric/oaktag pattern-cutting table.

The Microscopy Laboratory has the capability to analyze fiber and fabric blends to aid in both research and development.

EQUIPMENT/FACILITIES

Shade Room. This facility is set up to visually and instrumentally evaluate color and discriminate color differences on textile materials. The visual color-matching table is set up in accordance with the standards established by ASTM for discriminating color differences. This facility is used widely to establish shade standards and tolerances supporting the Army, Postal Program, AAFES, SOF, industry and academia.

The Helmet Impact Tester is an ANSI standard monorail impactor capable of simulating crash conditions for head impacts. The impact tester is used to assess new impact protective configurations in support of headgear research and development. Helmets are simply mounted to the test head form, raised to the required height (and corresponding drop velocity), and dropped onto a steel anvil. Velocity and deceleration measurements are taken to quantify the impact protective qualities of the helmet system.

Ballistic Evaluation of eye armor is obtained via a ballistic gun that projects fragments at speeds consistent with ANSI Z-87.1 and MIL-STD-662 specifications. Eye armor can be exposed to various weather scenarios in a weatherometer and then tested at extreme temperatures ranging from -73° to 200° C in a computer controlled environmental chamber.

Biomechanics Laboratory: The joint Natick Soldier Center/USARIEM research program in biomechanics studies forces in and on the human body, and the effects produced by those forces.

The Biomechanics Laboratory is unique in DoD. It consists of a 7,500 square foot dedicated laboratory outfitted with state-of-the-art equipment for three-dimensional analysis of human movement, measurement of external forces on the body, monitoring of muscle activity, and real-time mapping of pressure patterns associated with wear of clothing and equipment.

Spectrophotometer Evaluation of materials is accomplished with a Lambda 9 UV/VIS spectrophotometer. Optical densities up to 5.0 can be obtained as well as corresponding photopic, scotopic and P-43 phosphor transmissions.

The 3-D Digitizer is used to capture the 3-D data points necessary to define a solid object. Using the Digitizer, engineers and technologists are able to construct a 3-D model, which can be imported and manipulated by CAD/E software. This technology is particularly useful for items that have complex shapes and geometries.

The Modeling, Simulation and Analysis (MS&A) Center contains the necessary computer hardware and software for inserting fully outfitted dismounted warriors into distributed interactive simulations with other Research, Development and Engineering Centers. Additionally, computer software such as IUSS, JCATS, ModSAF, and Janus are used for constructive analysis or man-in-the-loop virtual simulations and rendered in 3-D by the MetaVR visualization system.

Materials Testing Laboratory: Scientists test packaging material for critical physical properties such as tensile/seal strength and barrier properties such as water vapor and oxygen transmission rate. Equipment includes: an Instron Tensile Strength/Seal Strength Tester, a Mocon Water Vapor/Oxygen Transmission Rate Tester, and a Headspace Oxygen Analyzer.

EQUIPMENT/FACILITIES

Flexible Packaging Laboratory provides prototype capability of new packaging system designs. Equipment includes: a Metal Traycan Sealer/Poly Traycan Sealer, a Vacuum/Gas Flush Heat Sealer, and a Pouch Maker.

The Container Testing Laboratory utilizes environmental chambers in conjunction with shipping tests to ensure the durability of military rations. Tests are conducted on shipping containers with assembled rations and pallet loads. Equipment includes: a Vibration Table, Environmental Chambers, a Drop Tester, a Horizontal Form-Fill-Seal Machine, and a Compression Tester.

Advanced Food Processing Laboratory. Offering pilot plant scale production equipment includes: temperature controlled meat-processing chamber, starch research and baking area with commercial scale ovens and proofers, freeze dryers, microwave assisted dryer, steam retort providing microwave assisted high temperature/short time processing, computer controlled twin screw extruder, and continuous processor/sealer system for production of pureed foods in collapsible tubes.

Laboratory Encruster Rheon Model KN300. Available for piloting plant test one Rheon Model KN300 Encruster. This equipment can extrude three components together to form a wide variety of food products with varying levels of the components.

Food Chemical Analysis Laboratory offers chemical, structural, and textural characterization of food samples, and includes a glucometer, pressurized microwave heater, chemical reaction calorimeter, molecular separator, low field nuclear magnetic resonance analyzer, texture analyzer, scanning confocal microscope, and viscometer.

Small Burner Test Facility allows combustion test and analysis of fossil fuel burners. Consists of exhaust hoods, thermal imager providing visual and digital infrared temperature profiles, combustion gas analyzer and sonic flowmeter. It can also perform sound measurement, combustion gas analysis, thermal performance, and heat exchanger efficiency.

Remote Controlled Ultralight Parachute Airdrop Aircraft can carry up to 900 pounds to a height of 5,000 feet with an airspeed of up to 125 miles per hour and release the load. This is a very cost-effective means for testing small size scaled parachute canopies. With onboard instrumentation, data is recorded and analyzed simultaneously.

Roller Test Facility simulates a C-141 aircraft roller bed. It has 136 instrumented rollers that are able to measure point loading of cargo within an airdrop aircraft. The Roller Test Facility is also equipped to simulate up to 80,000 lbs. of parachute extraction force.

A 45 foot high Drop Tower is available for the lifting and releasing instrumented airdrop loads up to 100,000 lbs. The Drop Tower is used to simulate the impact shocks that are exerted on parachute loads when they impact the ground.

550,000-pound Capacity Servo-Hydraulic Type Tensile Compression Machine applies controlled tensile/compressive loading to objects while measuring force and linear displacement. This machine provides uniform Forces/displacement throughout its 20-inch stroke and provides the capability to apply load or displacement in monotonic or cyclic control commands.

EQUIPMENT/FACILITIES

112,000-pound Capacity Screw Type Tensile/Compression Machine applies controlled tensile/compressive loads to objects while measuring the force and displacement. This machine provides uniform displacement throughout its nine-foot stroke.

Horizontal Impact Machine measures energy attenuation characteristics of materials during impact. This Machine applies dynamic impact (mass and velocity) loads to energy dissipating materials and measures material compression and acceleration characteristics.

Sensory and Consumer Testing Laboratory. This laboratory is capable of conducting a wide range of studies to characterize the sensory properties of and consumer responses to foods, beverages, fabrics, clothing items, and other consumer products. The laboratory makes use of other in-house facilities, including sensory descriptive panel rooms, focus group rooms, and two environmentally-controlled fabric conditioning rooms. Trained flavor, texture, and handfeel panels are available for descriptive sensory testing. Extant human use protocols enable testing of a wide range of FDA-approved and experimental products, and a large volunteer consumer panel.

Soldier and Biological Chemical Command RDEC
Aberdeen Proving Ground, MD 21010
(410) 436-5501
Technical Director, RDEC: Jim Zarzycki
Technical Director, NSC: Philip Brandler

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	1.875	N/A	N/A	1.875
6.1 Other	3.128	0.067	1.067	4.262
6.2	32.588	1.760	42.341	76.689
6.3	7.140	0.813	31.374	39.327
Subtotal (S&T)	**44.731**	**2.640**	**74.782**	**122.153**
6.4	6.928	0.057	1.511	8.496
6.5	4.225	0.350	3.013	7.588
6.6	1.918	0.121	7.018	9.057
6.7	0.439	0.016	0.615	1.070
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**58.241**	**3.184**	**86.939**	**148.364**
Procurement	1.266	N/A	15.928	17.194
Operations & Maintenance	68.565	N/A	28.452	97.017
Other	2.723	N/A	31.024	33.747
TOTAL FUNDING	**130.795**	**3.184**	**162.343**	**296.322**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	
TYPE	DOCTORATES	OTHER		END STRENGTH
MILITARY	0	0	35	35
CIVILIAN	50	575	728	1348
TOTAL	**50**	**575**	**763**	**1383**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	1222.000	**REAL PROPERTY**	143.000
ADMIN	375.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	485.000	**EQUIPMENT**	129.840
TOTAL	**2082.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.954
ACRES	**58**	* Subset of previous category.	

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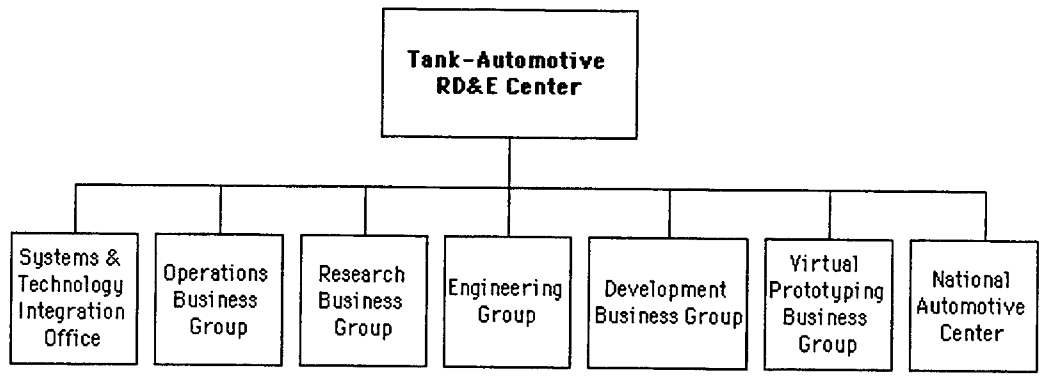
Tank Automotive RDEC

FY2000 Abbreviated Functional Chart - Technical Organizations



Tank Automotive RDEC
Warren, MI 48397-5000
(810) 574-6144

Commander: MG John S. Caldwell, Jr.
Director: Jerry L. Chapin

MISSION

To research, develop, leverage, and integrate advanced technology to provide soldiers with superior ground system and support equipment, and to provide engineering and technical support to ensure systems readiness throughout the life cycle.

CURRENT IMPORTANT PROGRAMS

In FY00, TACOM-TARDEC was responsible for six Defense Technology Objectives (DTOs) as well as 18 of the Army's 200 Science Technology Objectives (STOs) which include three Advanced Technology Demonstrations (ATDs).

DEFENSE TECHNOLOGY OBJECTIVES: DTOs are unique technology efforts critical to the fielding of technologically superior warfighting systems. DTOs for ground vehicles are: Future Scout and Cavalry System, Future Combat System, Advanced Ground Vehicle Electronic Systems, Advanced Ground Vehicle Mobility Systems, Combat Hybrid Power Systems, and Integrated Hit/Kill Avoidance Optimization.

ADVANCED TECHNOLOGY DEMONSTRATIONS (ATDs) focus TARDEC's Science and Technology (S&T) programs on current and future customer requirements while showcasing technological opportunities for advanced ground vehicle warfighting capabilities. The three ATDs are Future Scout and Cavalry System (FSCS) ATD, Crew Integration and Automation Testbed ATD and the Robotic Follower ATD:

Future Scout and Cavalry System (FSCS): The FSCS ATD integrates advanced technologies, including sensors, survivability, mobility, and communication technologies into a robust vehicle platform. Technologies and lessons learned about integration of FSCS technologies on a C-130 transportable platform are important to reduce risk and accelerate development and fielding of the Future Combat System (FCS). Contracts were awarded to two international industry consortium teams in January 1999. SIKA International is a joint venture between British Aerospace (BAe) Systems and Lockheed Martin (LM) with General Dynamics Land Systems (GDLS) and Vickers Defence as major subcontractors. The LANCER team is managed by BAe Systems as the prime contractor, with United Defense Limited Partnership (UDLP), Raytheon and Alvis as major subcontractors. During FY00, each contractor team defined software requirements; evaluated the affordability of hardware and software alternatives and system concepts; and completed subsystem and system trade studies to define cost effective hardware configurations (e.g., a $3 million-unit-production cost concept, a concept that at a minimum meets all of the draft threshold performance specifications, and a concept that optimizes a mix of cost and performance). Further specific program accomplishments in FY00 included the progression of system and subsystem design through the use of virtual prototypes and simulations, and initiation of Integrated Demonstrator fabrication. Preparation for the Three Star Affordability Review (AR), scheduled to be held in January 2001, continued during FY00. The aim of the AR is to examine different FSCS/TRACER concepts, and a range of associated issues, in order to focus the remainder of

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the program and Information Surveillance Targeting Acquisition Reconnaissance (ISTAR) Balance of Investment (BOI) on a program, which is both cost effective and affordable. The AR will result in a refined Combined Operational Requirements Document, which will be used by the consortia to focus their remaining ARD effort. The consortia submitted performance and life cycle cost data in October 1999, and additional information in September 2000 to aid the Operational Analysis (OA) community in preparing the documentation for the AR.

The Crew integration and Automation Testbed (CAT) Advanced Technology Demonstrator (ATD) will demonstrate the crew interfaces, automation, and integration technologies required to operate and support future combat vehicles. This ATD will produce multi-mission crewstations that will cover 100% of the Fight, Scout, and Carrier applications as well as embedded control of Unmanned Aerial Vehicles and Unmanned Ground Vehicles. These technologies and crew stations will be sized to meet the C-130 transportability requirements of the Future Combat Systems program. There will be an evaluation of alternative positions of crew stations using both front-to-back and side-by-side positioning. Specific technologies to be integrated include: helmet-mounted displays, head trackers, panoramic displays, intelligent driving decision aids, semi-autonomous driving technology suite, automated route planning, object-oriented software backplane, and a combat vehicle graphics map toolkit. MANPRINT issues will be addressed through human factors modeling and analysis early on and through soldier and system performance measurement during experimentation. By FY00, complete system engineering and design. By FY01, develop baseline semi-autonomous driving, route planning. By FY02, adapt and develop mission planning and rehearsal technologies and cognitive decision aids. By FY03, adapt and implement embedded training and complete development of driving technologies and decision aids. Technologies will be demonstrated on vehicle testbed. By FY04, develop embedded battlefield visualization, integrate helmet-mounted displays and panoramic displays, technologies will be demonstrated on vehicle testbed and perform Battle Lab Warfighter Experiment

The Robotic Follower ATD will develop, integrate and demonstrate the technology required to achieve unmanned follower capabilities for future land combat vehicles (e.g., Future Combat Systems (FCS)). This technology will support a wide variety of FCS/Objective Force applications such as Truck Carrier, Supply Platoon, NLOS/ BLOS Fire and Rear Security. A key tenet for the robustness and speed of the follower systems is the 'assistance' of the manned leader to provide a high-level proofing of the follower's path, avoiding areas that would impede or confuse the unmanned followers, which operate with minimal user intervention. This cooperative effort between TARDEC and ARL is focused on a series of demonstrations that will successively increase the follower performance and improve the maturity of the software algorithms, SMI and sensor technology for transition to the FCS program. In FY01 we will baseline follower technology on the Demo III XUV. To meet the 15 April 03 TRL 5 requirement for the FCS program, we will utilize the same Demo III XUV chassis, which have sufficient mobility to meet the interim exit criteria and demonstrate follower capabilities to FCS contractors. For the FCS program's 15 April 04 TRL 6 requirement, the technology will then be ported to a more mobile chassis that is capable of meeting the full exit criteria.

TECHNOLOGY DEMONSTRATIONS include TARDEC's non-ATD S&T programs and are formulated by Army agencies as a Science and Technology Objective (STO). Individually approved by the warfighting customer, each STO delivers a measurable new warfighting capability or a cost saving method to streamline ground vehicle acquisition and support investments. TARDEC STOs include: Survivability Technology Integration Program, Full Spectrum Active Protection, Integrated Armor Structure for Light Weight Vehicles, Advanced Signature Management for AAN, Ground Propulsion

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and Mobility, Intra-vehicular Electronics Suite, Detection Avoidance, Laser Protection for Ground Vehicle Vision Systems, Tank Mobility Technology, Combat Vehicle Concepts and Analysis, Concepts for 21st Century Truck-based Tactical Vehicles and Future Light Vehicle Ballistic Protection, and Obstacle Marking and Vehicle Guidance. Other non-STO efforts included robotics and Halon replacement in addition to a significant increase in both collaborative technology with industry and classified efforts. Three Science and Technology Objectives (STOs) for Petroleum and Water were approved during the FY99 STO Review. One of these, the Advanced Fuels and Lubricants STO, has completed work on the following studies: Fuel Demand Reduction, Fuels Logistics Demand Estimation, Modeling and Simulation, and Development of Roadmaps for Fuels and Advanced Lubricants. Draft reports are being written.

VEHICLE PERFORMANCE SIMULATION/VIRTUAL PROTOTYPING efforts are centered on exploiting advances in High Performance Computing and Simulation software to analyze and assess wheel and track ground vehicle performance over the entire life cycle of the vehicle system, from concept design through fielded system support. Our expertise in multi-body/flexible body analysis as well as finite element/structural analysis is used to analyze engineering issues as finite as individual component performance, up to whole vehicle system performance. Our expertise is used extensively to provide new vehicle system Source Selection Authorities additional insight into how proposed vehicle designs will perform while carrying out their directed missions. We are also called in to support Weapon System Managers, Program Managers and other decision makers to provide engineering solutions to problems in the field which preclude their system from meeting its mission requirement. Many of the state-of-the-art simulation tools we have at our disposal have been developed by TARDEC's Virtual Prototyping Group's researchers as part of our ongoing research program that keeps the Army's Simulation capabilities on the cutting edge of the technology. This technology allows TARDEC to provide vehicle system decision-makers with timely, accurate answers to their real world engineering questions, thereby keeping the Army's vehicle fleet the safest and most effective in the world.

US - JAPAN PROGRAM (part of the Ground Vehicle Mobility DTO). The U.S.-Japan Fighting Vehicle Propulsion Technology Using Ceramic Materials Cooperative Research Project (Ceramic Engine) is aimed at developing advanced engine technology which will permit a significant breakthrough in advanced combat vehicle propulsion systems. Critical elements of this project include advanced materials (to include ceramics), high temperature combustion optimization, low heat rejection technology and advanced technology for lubrication, friction and wear. The overall work tasks include analysis, engine demonstration, component optimization, reliability assessment and joint material component exchange and evaluation. The work offers an excellent opportunity to leverage U.S. and Japanese technology in order to accomplish aggressive objectives. DoD/Army benefits from this collaborative effort in the advanced monolithic ceramic material area in which Japan excels and is the perceived world leader. The project also addresses TARDEC corporate goals to significantly reduce propulsion system volumes for future combat vehicle applications.

FUTURE COMBAT SYSTEMS (FCS). The objective of the Future Combat Systems (FCS) effort is to develop lightweight (no individual element greater than 20 tons), overwhelmingly lethal, strategically deployable, self-sustaining and survivable combat and combat support force, systems and supporting technologies for the 2012-2025 timeframe and beyond. The Future Combat Systems will be a single multi-functional system (or system of systems) which optimizes performance of the force leveraging on the advanced technologies (with the capability to incorporate future advances). The Future Combat Systems program was authorized by the 7 February 2000 Memorandum of Agreement between the

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Defense Advanced Research Projects Agency and the United States Army for the Collaborative Demonstration Portion of the Future Combat Systems.

FCS awarded the initial concept contracts to 4 contractors in 5/00. It required the contractors to develop concepts, behavior models, and to evaluate those concepts utilizing standard modeling techniques. These contracts were focused on getting new ways of doing business for the Army. Innovative ways of looking at the Army's problems and 'out of the box' solutions for future warfare. Among the deliverables are evaluation and recommendations concerning which advanced technologies were utilized, modeling inputs, and organizational structures. The contractors will complete this concept contract 2Q02 and the phase II contract for demonstration of the concepts will be awarded.

ADVANCED SYSTEMS are based on concept study recommendations of the TARDEC's Advanced Concepts Team working with proponents in the US Army Training & Doctrine Command (TRADOC), Program Managers and other organizations. The major accomplishments for this year focused on the Future Combat Systems (FCS) program, Future Tactical Truck Systems (FTTS) program, and the Simulation Throughout the Life Cycle (SIMTLC) Advanced Concepts Pilot Program:

- Three families of preliminary concepts were developed for FCS based on: a modular vehicle approach, an articulated vehicle approach, and a network-centric robotic vehicle with command centers approach. The concepts were used in support of the HQ TRADOC Objective Force IIT requirements development and modeling, as input to the Army Science Board 2000 Summer Study and are being used in advanced visualization experiments with the Dave Automated Virtual Environment of CAVE.
- The SIMTLC Advanced Concepts Pilot Program Integrated Data Environment was successfully demonstrated to FCS program office.
- A heavy FTTS concept was developed based on ideas generated in the previous concepts which features hybrid electric drive, hybrid steer, advanced crewstation, modular armor, and a companion powered trailer. A robotic resupply system was also concepted.
- The concepts were developed in coordination with the DCD office at the Transportation School in support of efforts to investigate innovative ways to logistically support FCS.

EMERGING SYSTEMS are based on recommendations of warfighter-lead Integrated Concept Teams (ICTs) sponsored by the US Army Training & Doctrine Command (TRADOC). ICTs this year focused on future systems which include the Future Combat Vehicle (FCS) and Future Scout & Cavalry System (FSCS). During FY99, a TRADOC Robotics ICT focused on the use of unmanned vehicles.

FULL SPECTRUM ACTIVE PROTECTION (FSAP). The objective of the STO is to demonstrate an FSAP system design that can be integrated onto a ground combat vehicle which will provide hemispherical protection for ground combat vehicles against large caliber threats including tube launched kinetic energy (KE) and High Explosive Anti-Tank (HEAT) rounds. The goal is to develop a single universal countermeasure for protection against smart top attack, hit-to-kill Anti-Tank Guided Missiles (ATGM), and especially large caliber gun tube launched KE and HEAT threats. FSAP component technologies will be matured to Technology Readiness Level 6 in FY05. The FSAP approach is balanced in consonance with advanced armor technology, including development of armor system to capture residual debris and will consolidate Active Protection Technology Demonstrations. Basic Proof of Principal tests of three types of countermeasures were assessed to determine their applicability to defeat Kinetic Energy rounds. These countermeasures, including Blast, Blast/Frag, and

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Multiple Explosively Formed Penetrators (MEFPS) were each successful under a narrow range of conditions. These tests were conducted at APG and Socorro, N.M. This data is driving not only the adaptation of these technologies, but the FSAP system parameters which will be required. Additionally, Contact Fracture modeling and simulation has shown it to be an alternative for defeating KE close-in.

ADDITIONAL SIGNIFICANT TECH BASE ACCOMPLISHMENTS:

- **Advanced Protection and Protection Design Technology**: Developed an armor virtual prototyping system, which will reduce armor test costs by 25%. We are demonstrating an advanced armor system against KE threats at 65% the weight of Abrams.
- **Non-Ozone Depleting Substance Technology**: Completed performance testing and long-term toxicology studies of 6 alternative, fire extinguishing systems. Completed breakdown product studies of 8 alternative agents to Halon 1301 as acceptable fire suppressants for both combat vehicle engine and crew compartments.
- **Laser Eye Protection**: Produced a design concept for the replacement of combat vehicle periscopes that will protect the crewman against agile frequency laser threats.
- **Mine Blade Control**: Demonstrated a non-contact blade sensing system to control the blade depth of the Grizzly mine plow. This system will increase vehicle mine clearing speed, reduce power required and increase the effectiveness of the Army's principal mine clearing vehicle.
- **Obstacle Marking and Vehicle Guidance**: Demonstrated communication capability up to 25m in direct sunlight using pulse modulated light waves. Goals are to achieve 1200 baud communication rate and incorporate GPS technology into markers.
- **Robotics**: Demonstrated an innovative intelligent mobility robotic system for small robotic vehicles. This system combines computer control with a suspension and drive system with increased degrees-of-freedom over conventional drive systems. Increased maneuverability in tight situations, particularly in the urban environment will result.
- **Electromagnetic Fully Active Suspension**: Completed the fabrication and testing of an electromagnetic regenerative fully active suspension test vehicle on a HMMWV chassis. The testing was conducted at AOPG and demonstrated a 100% increase in cross-country ride limiting speed. This technology also provides increased chassis stability, reduced vehicle vibrations, greater platform stability for bun and sensor accuracy. The regenerative feature increases fuel economy and reduces vehicle signature. The vehicle can be raised and lowered for signature management and the platform automatically leveled for sensor mast performance.
- **Vehicle Detectability**: Completed a physiologic detection model for vehicle detection that has transitioned to a classified Army program. This model represents human detection to low observable vehicle technologies. This model will reduce test requirements and decrease development time.
- **Virtual Prototyping**: Completed an initial demonstration of an integrated virtual prototyping system for conceptual vehicles. This integration permits multiple models (signature, mobility, ballistic) to use a common geometric database allowing an integrated design environment.
- **Band Track**: The band track delivered a 50% weight reduction over conventional steel track. At the 15 ton weight class, the track exhibited little wear after 300 miles testing, an improvement over steel track. The initial design for the 25-ton weight class is complete. Performance testing on the 25-ton class band track met or exceeded all Bradley system performance requirements except one. Further improvements are being made for durability and mine blast survivability.
- **Semi Active Suspension**: The Bradley test rig completed 800 miles durability testing at Yuma Proving Grounds. This new external suspension saves 800 lbs. from the standard torsion bar suspension. The electronically controlled damping decreases vehicle pitch by over 50% in some

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scenarios. This results in greater gun accuracy, lower crew fatigue and faster vehicle speeds cross-country.

- **Bradley Electric Hybrid Demonstrator**: In conjunction with DARPA, completed the fabrication of an electric hybrid drive system for the Bradley vehicle. This state of the art drive system will provide increased fuel economy, greater performance and increased vehicle design flexibility over conventional drive systems.
- **Commander's Decision Aide**: Completed transition of the software and circuit card assembly for vehicle integrated defense to PEO-GCSS.
- **Active Protection System**: Designed and fabricated a full up functional end-to-end APS. Subsystem testing conducted and completed included: radar, gimbals, deployment mechanism, radar signal processor, and interceptor.
- **Electronic Sensors and Countermeasures**: Fabricated a 2 Color IR Sensor, Directable IR Countermeasure and Laser Target Decoy System performed lab testing and initiated live threat testing.
- **Signature Management**: Completed demonstration of a new generation of signature managed vehicle in field trials with soldiers. Results are classified.
- **Survivability Modeling**: Doubled the threatbase and model capacity of the Army's primary screening tool for survivability technologies. This model is in daily use by all TACOM vehicle prime manufacturers.
- **Vetronics Technology Testbed**: Completed first drop of the crewstation software. This vehicle-ready software enables the field demonstration of many of the technologies characterized by the Crewman's Associate ATD which resulted in a 50% reduction in crew task loading over the Abrams tank.
- **Combat Hybrid Power System (CHPS)**: Project management of the CHPS program has been smoothly transitioned from DARPA to TARDEC. Technical successes include laboratory demonstration of the multifunctional power distribution and management system, and operation of simultaneous pulse power and continuous power loads. On-going efforts include laboratory integration of advanced high power and energy density Li-Ion batteries and development of a SiC DC/DC converter.
- **Aluminum Metal Matrix Track**: Completed the fabrication and initial laboratory tests for a lightweight track system that reduces track weight 30% and increases durability 30% in a Bradley and FSCS weight class vehicle.
- **Joint Robotic Development Program on Ground Vehicle Survivability**: Demonstrated scalability of 100 and 1000 pound weight class unmanned ground vehicles (UGVs) to man-portable robot applications. Upgraded 100 pound UGV with omni-directional steering capability for 6-degree-of-freedom wheel control. Upgraded the 1000-pound UGV intelligent path planning and control algorithms.
- **IR Imaging Spectraradiometer**: Development of an IR imaging spectraradiometer for combustion product analysis in real-time.
- **Active Suspension Previewer**: Minimally demonstrated a HMMWV active suspension system with an integrated millimeter wave radar preview sensor. Advances are needed in the preview sensor arena to make this system more viable.
- **Support Vector Machine**: Implemented a support vector machine with recognition algorithm for suppressed targets in cluttered visual and IR backgrounds. Substantially enhances target recognition.
- **Directed Energy Performance Material**: Developed a model to predict the performance of directed energy limited materials.

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- **Large Scale Combustion Model**: Evaluated the Large Scale Combustion Model using TARDEC data from the Cummins VTA903 single cylinder engine.
- **POL Quality Analyzer and Sensors**: Conducted sensor development investigations in conjunction with the University of Dayton Research Institute, the Army Research Laboratory-Adelphi (Sensors and Electron Devices Directorate) and the Army Research Laboratory-NASA Langley (Vehicle Technology Directorate) to determine feasibility of selected on-board sensor technologies for monitoring engine oil condition and the level of contaminants.

SUPPORT TO PEOs included M1A2 System Enhancement Package (SEP), Bradley M2A3, Digitization of the Battlefield, Heavy Dry Support Bridge, Tactical Vehicle Mine Protection, Heavy Assault Bridge and Breacher (Grizzly).

WEAPON SYSTEM MANAGEMENT and CONFIGURATION CONTROL for 19 systems in development, 34 systems in production/deployment and 2801 systems in sustainment (vehicles and end items). This encompasses over 850,000 military ground vehicles, 300,000 unique spare parts equating to 2.5 billion components (average of 3,000 parts per vehicle). Configuration control was maintained via 934,000 drawings. System support includes: materiel & combat development integration, acquisition, concurrent engineering, manufacturing & producibility engineering, product assurance, engineering data management, validation of technical data, field technical assistance, specifications and standards, tech adaptation/development/integration/transition and test management.

EQUIPMENT/FACILITIES

TARDEC is the only Army/DoD Tank-Automotive Research, Development and Engineering Center committed to overall ground vehicle technology and integration.

NATIONAL AUTOMOTIVE CENTER, a joint venture with the American automotive industry and TARDEC is leading the way in 'dual use' of critical technologies.

PETROLEUM AND WATER CENTER laboratories and test facility were designated a National Water Center under the National Centers for Water Treatment Technologies program on 5 October,1998. TARDEC is one of only 5 National Water Centers in the country and the only DoD agency. The TARDEC Petroleum and Water Center facility includes state-of-the-art water quality and instrumentation laboratories, a test bay, and a separate test facility on the Lake Saint Clair shore with an enclosed boat well for protected source water access. The National Centers for Water Treatment Technologies program was established by the Department of the Interior's Bureau of Reclamation and the National Water Research Institute (NWRI). The purpose of the Centers is to facilitate research, development, and technology transfer between government, academia, and industry, in the areas of water supply, treatment and reclamation. It also promotes increased utilization of existing lab and research facilities, to allow industry and academia to leverage scarce resources.

PROPULSION LABORATORY. Provides a centralized physical test support capability for engineering experiments, test programs, and evaluation services in support of the Army's Research, Development, and Engineering programs associated with tracked and wheeled ground vehicle propulsion systems. Comprised of six computer-controlled engine, transmission, and driveline dynamometer

EQUIPMENT/FACILITIES

equipped test chambers; an Air Flow Lab dedicated to air cleaner, heat exchanger, and ballistic grille evaluations; and three dynamometer-equipped test chambers dedicated to wheeled and tracked vehicle evaluations. This laboratory features a unique environmentally-controlled tracked vehicle dynamometer equipped test chamber with wind, ambient temperature, and solar radiation simulation capabilities. Complete propulsion systems and components testing capabilities are available to address customer requirements during all engineering design phases.

TIRE LABORATORY. Provides full range of tire and roadwheel performance, endurance, and shock testing capability.

TRACK and SUSPENSION LABORATORY is used to conduct testing and evaluation of current and prototype combat vehicle components. Specific test systems include a track pad test machine, 1/4 HMMWV suspension test platform, three degree-of-freedom track loading, torsion bar test and linear shock absorber test. Generic capabilities are available for high static loading and endurance/fatigue test scenarios. Available linear and rotary hydraulic components and instrumentation allow for flexible test design and configuration.

ARMOR INTEGRATION LAB performs armor system fabrication and ballistic testing.

VISUAL PERCEPTION LABORATORY augments available field test data by providing a controlled environment to measure the detectability of signature management systems using trained military observers.

LASER PROTECTION LABORATORY develops and evaluates materials and techniques to harden combat vehicle surveillance vision optics against multiple laser hazards and threats. The efforts in this laboratory are teamed with activities conducted at the Air Force laser protection research laboratories at Wright-Patterson AFB, utilizing the strengths of each organization.

TERRAIN SENSING LABORATORY performs in-house live modeling and field test validation of sensor technologies for high-speed, high-definition terrain contour mapping. This capability can be applied to high-speed mobility, robotics vehicles and hit avoidance solutions while current efforts are focused on a solution for Grizzly Automatic Depth Control.

ENVIRONMENTAL TEST CELL performs high-temperature performance tests on vehicles.

VEHICLE ELECTRONICS (VETRONICS) LABORATORIES include: Combat Vehicle Systems Integration Lab composed of ADA-based vehicle-ready electronics, computer systems, and crew stations for proof-of-principle demonstrations of advanced and open electronic architecture approaches; Crew Station Simulator Lab composed of the following DIS compatible man-in-the-loop virtual simulators and support environments: 2/3 Man Tank, M2A3 HMMWV, MODSAF, ITEMS and virtual world/terrain modeling; Drivers Automation Lab composed of several tactical wheeled and combat vehicle systems with a variety of autonomous and semi-autonomous driving aids and sensors (e.g. collision avoidance system) and a base station for tele-operated field demonstrations.

COMBAT VEHICLE COMMAND AND CONTROL FACILITY provides an automated command and control system for armor/infantry vehicles, a tactical situation display in all vehicles, and supports the Army Horizontal Technology Insertion Program.

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TACOM GROUND VEHICLE SYSTEMS SIMULATION LABORATORY houses national resources for full-scale motion based vehicle simulation. The laboratory consists of a variety of simulators to perform man-in-the-loop crew stations turret motion base simulator CS/TMBS is the centerpiece of this laboratory. This unique 6-degree-of-freedom simulator is used to reproduce dynamic conditions encountered by combat vehicle crew stations and turret systems (up to 25 tons) and traverses a variety of terrain environments. In addition to the CS/TMBS, a ride motion simulator, a single crew person, six DOF high fidelity simulator, offers the capability of recreating the ride motion of any land based military vehicle system. In order to perform durability schedules, reconfigurable "poster" simulators are used to provide dynamic load inputs to ground vehicle systems and/or subsystems (tanks/trucks, hulls, frames, etc). In order to better test trailer systems, the laboratory has yet another unique one-of-a-kind capability: the Pintle Motion Base Simulator (PMBS). The PMBS is capable of providing both terrain disturbance inputs and dynamic pintle loads due to truck/trailer interaction.

LIGHTWEIGHT STRUCTURES LABORATORY performs materials test and structural tests, characterization and assessment of advanced composite materials using state-of-the-art ultrasonic test equipment, Dynatup impact tester and INSTRON high-capacity fatigue testing machine provided with automated advanced data acquisition and testing programs. This laboratory has also Vacuum Assisted Resin Transfer Molding (VARTM) equipment for making composite structural parts for automotive applications. The laboratory facilities are being used for conducting In-house Laboratory Independent Research (ILIR) programs on Composite Joints, Metal Matrix Composites (MMC) and Impact Dynamics. Additionally, the laboratory has the capability to prototype and analyze innovative lightweight vehicular structures.

JANUS SIMULATION LAB is used for the evaluation of Advanced Vehicle Technologies in operational scenarios. The lab consists of one server and two player stations allowing up to three players to simultaneously evaluate new system concepts/technologies in force-on-force scenarios.

The HIGH PERFORMANCE COMPUTING CENTER (HPC) operates a 64-processor Power Challenge Array (PCA) Parallel Processor computer and is collocated in this facility. It is one of only eleven DoD national shared-resource high-performance computer centers. In addition, this center provides computational capability for real-time inputs needed by the Ground Vehicle System Simulation Laboratory.

VIRTUAL PROTOTYPING LABORATORY is capable of displaying interactive computer-aided design solid model virtual mock-up of present and future ground vehicle systems. A wide range of state-of-the-art 3-D stereo display devices (helmet, boom, projection, and holographic) are used for interactive virtual mock-up of vehicle systems and manufacturing facilities. In addition state-of-the-art CAD workstations directly networked to the HPC PCA will allow real-time interactive immersive environments for virtual mock-up of vehicle systems.

BRIDGE TEST FACILITY is used for testing static or dynamic cyclic loads on various bridge designs. The purpose of this project is to provide a capability for conducting physical simulation testing of full-scale hardware and to reduce system development testing cost to the customer. The goal is to provide a facility that can simulate durability vehicle crossings over mobile military bridges, structural strength testing in accordance with the Trilateral Design and Test CODE for Military Bridging and Gap Crossing Equipment (CODE) and for performing engineering test on advanced concepts. The system will use

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advanced software and an acquisition system, which will duplicate and maintain the strains/loads, as experienced during actual crossings, to meet the required statistical number of crossings. The system will also have the capability to apply loads up to and including 1.5 times the working load in order to validate the design in accordance with the CODE, to achieve materiel release and to provide a Military Load Classification (MLC) value. The system will also have the flexibility to simulate experimental loading conditions and loading profiles.

WATER QUALITY AND WATER TEST CELL LABORATORIES are used for the testing of various water filter elements, water filter systems, and providing chemical analytical support to water purification engineer functions.

FUEL EQUIPMENT TEST LABORATORY are used for testing and evaluating fuel pumps, fuel filter elements, fuel filter separators, fuel nozzles and engine fuel filter elements.

GREASE AND FLUID LABORATORY performs development, evaluation, and environmental compliance assessments of hydraulic fluids, semi-solid lubricants, solid lubricants, antifreeze, and solvents to enable introduction of new technologies and development of new performance standards.

FUELS AND POWERTRAIN LUBRICANTS LABORATORY performs development, evaluation, qualification, and environmental compliance assessments of fuels, alternative fuels, and powertrain lubricants (i.e., engine oils, gear lubricants, and transmission fluids) to enable introduction of new technologies and development of new performance standards.

FUELS AND LUBRICANTS RESEARCH FACILITY (SwRI) a Government-owned, contractor-operated facility at the Southwest Research Institute in Texas, is a one-of-a-kind resource where integrated fuels-lubricants-engine systems research and development programs involving combustion, performance characterization, engine cleanliness, vulnerability assessments, and tribology can be performed.

ROBOTICS LABORATORY is a subscale autonomous locomotion laboratory, which evaluates small vehicle mobility and autonomous vehicle obstacle avoidance algorithms. Research is conducted in automated route planning and obstacle avoidance.

CONCEPTS LABORATORY provides 3-D CAD future vehicle concepts, design, and analysis up to and including Secret, Special Access programs (SAP), and Top Secret studies.

OTHER facilities and equipment include: software engineering, signature, dynamic motion simulator (seat simulator), fabrication, computer-aided design, Laminate Object Manufacturing (LOM) rapid prototyping system, packaging engineering, model shop, metallurgical, mechanical test, animation capabilities used in support of virtual prototyping, rapid prototyping, visualization capabilities, sheet/metal welding, machine shop, assembly shop, electrical, battery test, instrumentation, IR imaging, thermal wave microscopy, applied engineering, scanning electronic microscope, and material spectrum analyzer.

Tank Automotive RDEC
Warren, MI 48397-5000
(810) 574-6144

Commander: MG John S. Caldwell, Jr.
Director: Jerry L. Chapin

FY2000 FUNDING DATA (MILLIONS $)

APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	1.214	N/A	N/A	1.214
6.1 Other	0.932	0.000	5.167	6.099
6.2	10.731	8.201	48.370	67.302
6.3	0.469	15.876	176.545	192.890
Subtotal (S&T)	**13.346**	**24.077**	**230.082**	**267.505**
6.4	2.731	0.000	0.446	3.177
6.5	2.221	0.000	0.396	2.617
6.6	3.145	0.000	10.330	13.475
6.7	1.305	0.000	1.775	3.080
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**22.748**	**24.077**	**243.029**	**289.854**
Procurement	22.078	N/A	1.820	23.898
Operations & Maintenance	16.848	N/A	12.294	29.142
Other	13.983	N/A	8.591	22.574
TOTAL FUNDING	**75.657**	**24.077**	**265.734**	**365.468**

MILITARY CONSTRUCTION (MILLIONS $)

Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)

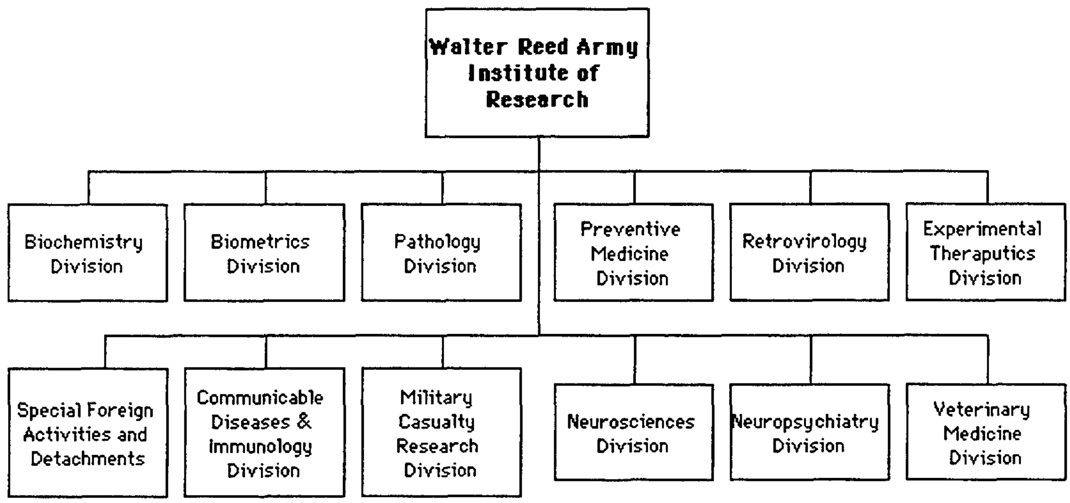
TYPE	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	END STRENGTH
	DOCTORATES	OTHER		
MILITARY	0	7	6	13
CIVILIAN	26	626	383	1035
TOTAL	**26**	**633**	**389**	**1048**

SPACE AND PROPERTY

BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	530.949	**REAL PROPERTY**	142.474
ADMIN	174.870	* NEW CAPITAL EQUIPMENT	0.353
OTHER	22.202	**EQUIPMENT**	278.133
TOTAL	**728.021**	* NEW SCIENTIFIC & ENG. EQUIP.	8.785
ACRES	**101**	* Subset of previous category.	

Walter Reed Army Institute of Research

FY2000 Abbreviated Functional Chart - Technical Organizations



Walter Reed Army Institute of Research
Silver Spring, MD 20910-7500
(301) 319-9100

Director: COL Daniel L. Jarboe
Deputy Director: COL Charles E. McQueen

MISSION

The Walter Reed Army Institute of Research (WRAIR) has one primary mission: biomedical research focused on soldier health and readiness. During military operations, the WRAIR provides America's soldiers with the tools and knowledge to survive hostile, disease-ridden, and health-threating environments. The Institute fulfills its mission by conducting innovative research in naturally occurring infectious diseases, combat casualty care, operational health hazards, and medical defense against chemical and biological weapons.

CURRENT IMPORTANT PROGRAMS

Current important programs at WRAIR focus on military infectious diseases, combat casualty care, army operational medicine, medical chemical and biological defense, education and technology transfer.

MILITARY INFECTIOUS DISEASES

The challenge of the military infectious diseases program is the prevention of disease based on evaluation, control and treatment of naturally occurring infectious disease threats to the U.S. military personnel. The program is very diverse encompassing several research areas including: epidemiology, disease prevention, development of diagnostic systems, identification and control of insect vectors, and development of drugs and vaccines for treatment and prevention of infectious diseases. Epidemioligical studies and diagnostic devices capable of detecting natural infectious disease agents form the basis for disease evaluation. WRAIR is developing diagnostic capabilites to identify pathogens in diverse clinical specimens such as respiratory secretions, blood, urine, cerebospinal fluid and in skin lesions. Equally important is the identification of drug resistance particularly with diseases like malaria where resistance is increasing. The development of efficacious vaccines for diarrheal diseases, human immunodeficiency virus (HIV/AIDS), viral hepatitis and vector borne diseases such as malaria, dengue, scrub typhus and leshmania constitute major efforts in disease prevention and control. Likewise, the identification and control of insect vectors of infectious diseases through the use of insecticides and repellents are part of the control program to protect the soldier. Treament involves the development of new drugs at WRAIR is focused primarily on malaria. Selected candidate drugs and vaccines are clinically tested for safety and efficacy on-site at the WRAIR with expanded clinical trials often occurring at sites where the disease is endemic.

COMBAT CASUALTY CARE

The WRAIR program in combat casualty care focuses its efforts on reducing the mortality rate of wounded soldiers especially within the crucial first hour after injury. The development of computerized devices such as the LSTAT (Life Support for Trauma and Transport), a miniatured intravenous fluid resuscitation pump, and a hand-held battery-powered x-ray unit are examples of systems that will allow medics to provide quality care to wounded soldiers on the battlefield. Improvement of maxillofacial care following tramatic injury is part of the program mission of military dentistry. Scientists developing improved strategies for combat wound management actively perform research on: 1) the biochemical and physiological aspects of traumatic injury and tissue recovery 2) methods or devices to reduce battlefield complications for blood loss, such as glue-like compounds that can seal the edges of wounds

CURRENT IMPORTANT PROGRAMS

and bandages impregnated with purified, virally inactivated human clotting proteins; and 3) the development of methods to microencapsulate antibiotics or other drugs for time release delivery

ARMY OPERATIONAL MEDICINE
Operational medical research focuses its efforts on 4 primary research efforts: sleep management and performance enhancement, operational stress, non-ionizing radiation and medical effects of military weapons systems. The key research projects on sleep management examine the quality and quantity of sleep needed to maintain soldier performance, judgement and problem solving ability. Specific projects include: 1) agents that induce or reverse sleep that are safe and do not impair performance, 2) personal sleep monitors that can predict soldier performance, and 3) computer models that can predict performance based on sleep doses. Researchers in the area of operational stress are studying the biochemical components of stress to mitigate strategies and treatments. WRAIR social and behavioral scientists have formed Human Dimension Teams and have deployed with troops to study operational stress and prevent stress reactions. Lasers produce non-ionizing radiation that presents a significant risk to a soldier's eyes and vision. WRAIR has 4 programs related to laser exposure: bioeffects, injury registry, evaluation and treatment. Together they are focused on protecting soldiers from directed energy systems on the battlefield. WRAIR conducts research to prevent injuries from military weapons systems with two key areas of research: blast overpressure and exposure to toxic substances. WRAIR scientists conduct research that aids in the development of safety criteria for operations. The evaluation of toxic hazards from weapons systems is an essential part of the operational medicine program.

MEDICAL CHEMICAL AND BIOLOGICAL DEFENSE
The challenge for WRAIR is to create products that will effectively protect against or treat the effects of chemical and/or biological warfare agents while not interfering with the soldier's performance. Chemical warfare agents kill or disable soldiers through 3 main mechanisms: interference with biochemical communication between nerves and muscles (nerve agents), disruption of respiration (cyanide) and burns (vesicant war gases). WRAIR's research efforts to develop a candidate cyanide pre-treatment that will protect soldiers at risk of exposure are at an advanced state. Antivesicants are also under development. Improved methods for counteracting or protecting against the effects of nerve agents are an integral part of the program mission. Research focuses on development of bioscavengers, chemical treatments that will bind with nerve agents in the body and maintain or restore communication between nerve an muscles cells. WRAIR's program in biological warfare has one goal: producing safe and efficacious vaccines that will protect the soldier. Active research is conducted primarily with two agents: staphyloccocal enterotoxins, toxins that can cause immediate systemic shock, and brucellosis, a debilitating, highly infectious disease.

EDUCATION
WRAIR sponsors formal accredited training programs. The 2-year General Preventive Medicine Residency program trains military doctors to identify and develop sound health strategies that will alleviate military health problems. The Clinical Pharmacology Fellowship is a 2-year program in partnership with the Uniformed Services University of Health Sciences (USUHS). Its graduates help meet the need of the Army Medical Department for clinical pharmacologists working in drug development, chemical casualty care and clinical research. The 2-year residency in Laboratory Animal Medicine given in partnership with USUHS and the Public Health Service, trains all the Department of Defense's specialists in Laboratory Animal Medicine. In addition to these formal programs, WRAIR also supports a Medical Research Fellowship, participates in the Army's Tropical Medicine Course, and teaches veterinary workshops.

CURRENT IMPORTANT PROGRAMS

TECHNOLOGY TRANSFER

Through an active technology transfer program, which includes cooperative research and development agreements (CRADAs), material transfer agreements (MTAs), patent disclosures and patent licenses (PLAs), WRAIR has a productive working relationship with universities, private industries and research foundations. In FY00 there were 19 new CRADAs executed. Three examples of FY00 accomplishments related to projects initiated by CRADA projects include:

1. Demonstrated that in a malaria challenge model an antimalarial, malarone, was 100% effective as a prophylaxis against Plasmodium Falciparum, the causative agent of one of the human malarias.
2. Demonstrated exposure of swine workers to Hepatitis E virus as a result of unnatural flooding conditions that occurred in North Carolina in FY 00.
3. Initiated a pivotal Phase II Clinical Trial of a prime-boost candidate preventive vaccine against HIV/AIDS in Thailand.

EQUIPMENT/FACILITIES

Facility Locations:

Forest Glen Annex Site, Silver Spring, Maryland

A new building co-locating the Walter Reed Army Institute of Research and the Naval Medical Research Center was dedicated in October 1999. The research center is located within a 27 acre site of the WRAMC Forest Glen Annex in Silver Spring, Maryland. The state-of-the-art facility covers 474,000 square feet and contains 125 laboratories making it one of the 10 largest federal laboratories, and the largest DoD research facility.

WRAIR has unique facilities that provide the following capabilities:

1. Ability to manufacture GMP-grade vaccines/biologics and clinically test these products on-site in Phase I/II Clinical Trials. The Pilot Bioproduction Facility is located in 2 buildings adjacent to the research center. There are 25,000 sq. ft. of space comprising 5 cleanrooms with a fermentor capacity from 30-300 liters. The Clinical Research Ward is an outpatient facility that processed over 5000 outpatients in FY00. The 3500 sq. ft. unit contains offices, exam rooms, a processing lab, a phlebotomy room, and patient waiting and resting areas.
2. Capability to perform resident sleep, circadian rhythm and performance studies on 8 human volunteers concurrently. The 1990 sq. ft. sleep facility is comprised of two suites, each containing a large living room, a kitchenette, a separate testing room and 4 bedrooms.
3. Ability to rear and infect medically important insect vectors with infectious diseases such as malaria and leshmania. The facility contains 1,400 sq. ft. of space and contains 8 walk-in incubators, a media preparation room, 2 transmission rooms where insects are infected via infected cultures or animals and a suite specifically designed for conducting human challenge studies.

EQUIPMENT/FACILITIES

CONUS Detachments:

- Brooks Air Force Base - San Antonio, Texas
- Dental Research Detachment - Great Lakes, Illinois

OCONUS Detachments:

- U.S. Army Medical Research Unit (USAMRU) - Heidelberg, Germany
- U.S. Army Medical Research Unit (USAMRU) - Nairobi, Kenya, Africa
- Armed Forces Research Institute of Medical Sciences (AFRIMS) - Bangkok, Thailand

Walter Reed Army Institute of Research
Silver Spring, MD 20910-7500
(301) 319-9100

Director: COL Daniel L. Jarboe
Deputy Director: COL Charles E. McQueen

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	2.099	N/A	N/A	2.099
6.1 Other	10.565	0.000	0.000	10.565
6.2	31.188	0.000	0.000	31.188
6.3	9.272	0.000	0.000	9.272
Subtotal (S&T)	**53.124**	**0.000**	**0.000**	**53.124**
6.4	5.746	0.000	0.000	5.746
6.5	1.167	0.000	0.000	1.167
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**60.037**	**0.000**	**0.000**	**60.037**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	14.182	N/A	0.000	14.182
Other	15.152	N/A	0.000	15.152
TOTAL FUNDING	**89.371**	**0.000**	**0.000**	**89.371**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	
TYPE	DOCTORATES	OTHER		END STRENGTH
MILITARY	97	61	181	339
CIVILIAN	71	161	150	382
TOTAL	**168**	**222**	**331**	**721**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	513.706	**REAL PROPERTY**	274.000
ADMIN	53.810	* NEW CAPITAL EQUIPMENT	4.800
OTHER	11.100	**EQUIPMENT**	47.600
TOTAL	**578.616**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**0**	* Subset of previous category.	

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DEPARTMENT OF THE NAVY

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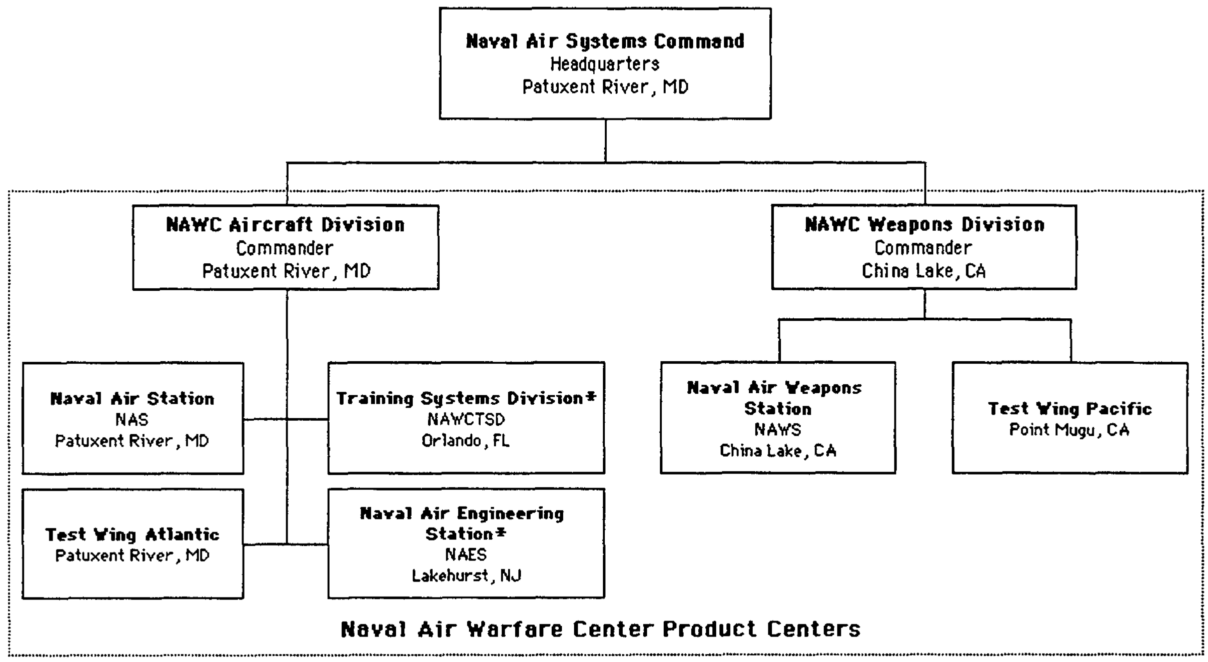
DEPARTMENT OF THE NAVY

The Navy's nine (9) In-House RDT&E Activities are:

****NOTE:** The four Naval warfare centers provide full spectrum research, development, test and evaluation, engineering, and fleet support services and perform a substantial amount of non-RDT&E work. Prior to FY1998, the Navy reported each warfare center in its entirety, even though a considerable amount of the reported end strengths, funding, and other resources were devoted to other than RDT&E programs. For purposes of more accurately reflecting RDT&E In-House resources in this report, the Navy has applied the established RDT&E In-House criteria (i.e., a minimum of 25% of total funds is RDT&E and a minimum of 25% of in-house effort is devoted to RDT&E) at the division or major site level rather than reporting all warfare center sites, regardless of their level of RDT&E work. <u>As a result, some warfare center entities have been eliminated from this report because they are below the 25% RDT&E threshold for inclusion in this report.</u>*

Naval Air Warfare Center

FY2000 Abbreviated Functional Chart - Technical Organizations



** As a result of applying the In-House RDT&E Activity criteria at the division or major site level (see NOTE on page 3-1), NAWC Training Systems Division and NAWC Aircraft Division Lakehurst Activity data is not included in the FY2000 report. The additional business base contributed by these two activities is $1.13B for Training Systems Division and $0.52B for Lakehurst.*

Naval Air Warfare Center
Patuxent River, MD 20670-1547
(301) 757-7825

Commander, NAVAIR: VADM Joseph Dyer
Deputy Commander, NAVAIR: Dr. Alan Somoroff

MISSION

The Naval Aviation Systems Team, in partnership with industry and academia, serves the Nation and the Navy by developing, acquiring and supporting naval aeronautical and technologically related systems with which the Operating Forces, in support of the Unified Commanders and our Allies, can train, fight, and win.

As part of that Team, the Naval Air Warfare Center, provides our forces with effective and affordable integrated warfare systems and life cycle support to ensure Battlespace Dominance from the sea. The Naval Air Warfare Center is the Navy's principal research, development, test, evaluation, engineering, logistics, and fleet support center for information technologies, air platforms, autonomous air vehicles, aircraft engines, free-fall and glide weapons, missiles, energetic materials, precision guided weapons, targeting sensors, crew and aircraft survivability systems, mission and planning support systems, electronic combat systems, and acquisition and support of fleet training systems. The Naval Air Warfare Center actively participates in all phases of the aircraft system's life cycle, including acquisition support, technology demonstration and validation, engineering and manufacturing development (EMD), production and deployment, fleet operations, fleet in-service engineering, system configuration upgrades, modeling and simulation of integrated warfare systems, and demilitarization of retired systems.

CURRENT IMPORTANT PROGRAMS

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION

The **Crew Systems Ejection Tower Team** conducted airworthiness qualification testing of life support equipment for the Republic of Singapore Air Force the week of 23 February 2000. Testing was completed on schedule, and the Singapore representatives include members of the Defense Medical Research Institute.

An in-house laboratory independent research program on an **Electromagnetically Induced Transparency (EIT)** for magnetometers and narrow bandwidth atomic filters was funded for FY00. The three-year program will explore EIT as a technique to detect variations in the local magnetic field that are orders of magnitude smaller than current capability. The successful demonstration of this new technique will benefit the airborne antisubmarine warfare community by providing an ultrasensitive detector to locate threat submarines and subsurface mines, and will also enhance search-and-rescue capability to locate downed aircraft.

On 3 December 1999, John Hollingsworth submitted the annual report to Congress on the molecular sieve oxygen generating system foreign comparative test program. The report included a summary of work accomplishments and future plans, and described the relationship with U.S. Air Force and the LOX-to-OBOGS program.

The **Cockpit Accommodation Team** evaluated 30 subjects in the man-machine integration laboratory for the U.S. Army RAH-66 Comanche program.

CURRENT IMPORTANT PROGRAMS

The **Aircraft Environmental Hazards Laboratory** successfully completed an outwash wind measurement sweep on an 80-foot radius (from thrust center). These tests were conducted on the Boeing short takeoff vertical landing variant at the Pratt and Whitney facility in West Palm Beach, FL. This data will be used to establish dynamic pressure and thermal hazard zones on the Joint Strike Fighter (JSF) aircraft.

JSF ground crew hearing protection completed Joint Aeronautical Commanders Group (Science and Technology Board) and Deputy Under Secretary of Defense (Science and Technology) reviews of JSF noise and proposed hearing protection solutions.

Navy Aircrew Common Ejection Seat (NACES) preplanned product improvement (P3I) was successfully tested at the supersonic Naval Ordnance Research Track Facility, China Lake, CA. Aspects of test include:

- An NACES P3I demonstration of phase II Pintle rocket motor capability.
- Test configuration was NACES with phase I catapult incorporated, modified bucket to accommodate Pintle rocket motor and controller, Martin-Baker electronic timer, and shortened start switch cables (12.8 inches).
- Test parameters were ground level, 0 KEAS sled velocity, 6-knot winds, and 69^0F outside air temperature.
- Seat and Pintle rocket initiation appeared normal. The initial evaluation trajectory conformed to performance predictions.

The first modified NACES (P3I) flew in the F/A-18 in June 2000. This will eventually be the standard fleet configuration for T-45s and NACES-equipped F/A-18s, as the change includes retrofit and new production.

"Operation Creates Havoc" Field Test: The Electro-Optic Sensors Branch completed highly successful field tests at the Atlantic Undersea Test and Evaluation Center (AUTEC) between 22 April and 5 May 2000 as part of a joint exercise known as "Operation Creates Havoc," sponsored by the Office of the Secretary of Defense (OSD) and the United Kingdom (UK) under the Ministry of Defense. This exercise was the first use of the P-3 test platform identified to support OSD and PMA-264 research and development initiatives. Three sensors were installed in this platform and operated simultaneously: a polarimetric scanning radiometer, hyperspectral imaging sensor manufactured by ATPI, and infrared (IR) camera developed by Defense Engineering and Research (UK).

Members of the chemical/biological (CB) team went to the Federal Bureau of Investigation (FBI) Academy in Virginia on 31 May 2000 to train the Hostage Rescue Team (HRT) on use of aviation CB protective gear. NAWCAD provided equipment, training, and maintenance support for the FBI HRT aviators.

A-37 Counterdrug Upgrade Program: The Night Vision Imaging System (NVIS) group, supporting the DoD Counterdrug Technology Program Office (DoDCDTPO), completed modifications on 20 Colombian and Peruvian A-37 aircraft. This nighttime capability will allow these aircraft to safely and effectively apprehend suspected drug smuggling aircraft in these countries. The A-37 is the primary interceptor aircraft for these countries to stop illegal drug production and trafficking within their respective countries (Colombia provides 90% of the cocaine used in the U.S.). The DoDCDTPO goal is to develop technology and prototype systems to enhance the counterdrug capability of DoD. Civilian

CURRENT IMPORTANT PROGRAMS

law enforcement agencies, consistent with the goals of the National Drug Control Strategy and the DoD mission, employ a systems approach and concentrate on opportunities where technology can assist to interrupt the flow of illegal drugs. The DoDCDTPO is the technology application arm and is overseen by the OSD Office of Counterdrug Enforcement Policy and Support.

Special Project 417: During several demonstrations, remotely operated telescope surveillance and data dissemination architecture was shown to the Deputy Assistant Secretary of Defense for Special Operations and Low Intensity Conflict, and Director, Joint Operations (J3). As a result of successful demonstrations, combined with technical briefs, Special Project 417 was initiated by DoD with NAWCAD as the lead laboratory.

The advanced personal air-conditioning system, a component of the **Helicopter Aircrew Integrated Life Support System (HAILSS)**, was received for demonstration in the H-60. The HAILSS is a systems-integrated approach to aircrew life support and includes head-to-toe protection against thermal (hot-cold), fire, and CB threats within a single ensemble.

Agusta Aerospace Corporation funded NAWCAD to test the fit and functionality of a new gun mount for the M240B gun on the A109E helicopters being leased to the U.S. Coast Guard.

The **Atlantic Ranges and Facilities Department (AR&F) Communications Team** modified the Atlantic Test Range's Sure-Track safety system for use as a mobile radar surveillance system. It will be deployed in Texas in late spring for evaluation by the Drug Enforcement Agency.

"Telemetry Anywhere" (TMA) Initiative: The TMA system was operational on a demonstration basis between Lakehurst and Patuxent River on 12 June 2000. F/A-18 F1 departed Patuxent River on 12 June 2000 with telemetry coverage via Patuxent River antenna and the real-time telemetry processing system (RTPS) and arrived at Lakehurst with a Patuxent River trailer-mounted antenna installed there, providing telemetry back to RTPS via TMA. The TMA system combines the fiber optics connectivity provided via the Defense Research and Engineering (DREN) network with a combination of loaned and borrowed asynchronous transfer mode equipment to connect telemetry, video, and voice communications between Lakehurst and Patuxent River in real-time. This system was maintained operationally throughout the F-1 detachment so project engineers could assess its usefulness and cost saving potential.

National Aeronautics and Space Administration/Naval Research Laboratory (NASA/NRL): AR&F completed electromagnetic interference testing of the interim control module for the international space station. The module arrived from NRL on 12 July 2000 and departed on 3 August 2000.

Air Combat Environment Test and Evaluation Facility (ACETEF) was a leading participant in JSF Virtual Strike Warfare Environment-7 exercises from 5 to 30 June 2000. This was a high-level architecture, real-time distributed simulation between ACETEF Patuxent River, Simulation and Analysis Facility (SIMAF), Wright Patterson AFB, and 412th Test Wing Air Force Flight Test Center, Edwards AFB. The exercise was conducted over DREN using FASTLANE encryption gear. Four virtual cockpits were used, two at ACETEF and two at SIMAF, along with man-in-the-loop red integrated air defense operators at Edwards. Hardware-in-the-loop demonstrations were conducted at SIMAF and ACETEF. The event was a resounding success, with six models running at ACETEF, two at SIMAF, and one at Edwards. JSF measures of effectiveness were obtained using real-time distributed simulation with time delays within acceptable ranges.

CURRENT IMPORTANT PROGRAMS

The **Electromagnetic Environmental Effects (E3) Division** completed electromagnetic compatibility/electromagnetic vulnerability (EMC/EMV) testing of the USCG HH-60 on 8 September 2000. Systems under test were the embedded global positioning system/inertial navigation system (GPS/INS) and a commercial-off-the-shelf helmet-mounted camera for the rescue hoist operator.

AH-1W: Electronic Warfare (EW) suite range data flights for sensitivity and direction of arrival were completed, as well as flight testing on ranges. Ground proximity warning system (GPWS) flight test on AH-1W BuNo 165359 was completed. Ground and flight tests on the AN/AVS-9 night vision goggle (NVG) were completed, with flight testing taking 6.2 hours. EW suite evaluation developmental testing (DT) was completed.

C-2A: BuNo 162142 completed the final flight for the low-probability-of-intercept altimeter (LPIA) technical evaluation (TECHEVAL) on 17 May 2000.

YCH-60S: Phase I organic airborne mine countermeasures static tow tests were successfully completed. Testing consisted of tethered tow critical azimuth under test day conditions, tethered tension sweeps, tethered skew sweeps, and fixed stabilator sweeps.

E-2C/NP2000: The team successfully completed the first test cell engine run of the NP2000 propeller system attached to the T56-A-427 engine. Three-tail loads flights were completed. Baseline flight testing was completed the week of 27 March 2000. The team completed a cockpit display and controls evaluation, and emergency procedures were evaluated. The first engine start was accomplished.

E-6B: Prototype BuNo 164408 modified miniature receive terminal operational test (OT) flights were completed on 7 March 2000. TEMPEST (Test for Electromagnetic Propagation and Evaluation for Secure Transmission) and ground testing, and a single flight test were completed on the cryptograph modification program modified E-6B.

EA-6B: DT flight testing of the USQ-113(V)3 communication jammer was completed after 30 flights/73.1 flight-hours. Initial DT/OT ground testing of the NVG modification was conducted at Patuxent River 6-10 March 2000. Ground testing on the Block 89 NVIS lighting modification was successfully completed at the air test and evaluation facility hangar. Deficiencies were corrected, and a flight clearance was approved for flight test.

F/A-18A-D: Advanced Tactical Airborne Reconnaissance System: Operational evaluation (OPEVAL) flight testing and data link E3 tests were completed.

Embedded GPS/INS (EGI): Autopilot compatibility tests were completed. Catapult launches, arrested landings, and Precision Approach and Landing System (PALS) flight tests were completed. Ship suitability testing was successful.

Shared Airborne Reconnaissance Pod (SHARP): Successfully completed F/A-18E/F SHARP Long-Range Optical Photography System (LOROPS) risk reduction propulsion tests. All F/A-18E/F SHARP LOROPS risk reduction load/flight qualities and performance test flights and all but one noise and vibration (N&V) test event were completed between 16 February and 9 March 2000.

CURRENT IMPORTANT PROGRAMS

The **LPIA** receiver/transmitter configured with software version 1.17 completed flight testing.

Tactical Aircraft Moving Map Capability TECHEVAL hardware and software test flights were completed.

The **F/A-18C/D** team's revised departure recovery procedure was released and incorporated into the NATOPS manual. The team successfully completed an air-refuel proximity evaluation behind a Boeing 767 along with the S-3 team.

ARC-210 Digital Communication Systems: Baseline ARC-210 functional tests were completed on the F/A-18C/D, along with EMC and ship suitability tests.

F/A-18E/F: Testing on the engineering and manufacturing development aircraft included weapon separation testing, completion of joint stand-off weapon EDTV (environmental determination test vehicle) N&V survey, AIM-9X/AIM-120C N&V survey, and laser eye protection evaluation at night.

The OPEVAL report was released on 14 February 2000, and the F/A-18E/F was deemed operationally effective and suitable by VX-9 and COMOPTEVFOR, as well as recommended for full fleet introduction.

ALE-55: Systems ground tests and three flight tests were conducted, with good results for the ground checkout system and unsatisfactory results for flight testing.

Landing Systems: Flight control computer operational flight program (FCC OFP) v8.0 automatic carrier landing system (ACLS) testing was completed. The third F/A-18E/F sea trials were completed on 10 April 2000 aboard the USS ABRAHAM LINCOLN. All primary test objectives were achieved. ACLS performance with new flight control system gains was satisfactory for shipboard Mode I operations.

The first **Joint Direct Attack Munition (JDAM)** separation from the E/F was conducted on 24 March 2000.

5-Wet Stations Separation Testing: Three jettisons were conducted with good separation characteristics. Tests were conducted during the week of 12 June 2000 and included catapult launch tests of 5-wet station loading, jet blast deflector compatibility, and E-28 arresting gear compatibility.

Avionics Integration EGI (Embedded GPS/INS): Completed catapult launches and arrested landing tests with no discrepancies or anomalies. Ship suitability testing for EGI was successfully completed. Completed PALS flight test.

Internal Fuel Tank Air Pressurization (IFTAPR) Elimination: Flight testing to evaluate the feasibility of eliminating the IFTAPR and associated hardware was completed. Results indicated that feasibility of IFTAPR removal exists, in that worst-case pressure differential between the bag and installed cavity (negative pressure) remained within the design allowable.

E5 ALE-55 Ground Test: Ground tests were conducted 15 and 16 June 2000 to check environmental control system cooling to integrated defense electronic countermeasure equipment, verify preliminary

CURRENT IMPORTANT PROGRAMS

loading and checkout procedures, conduct aircraft optical insertion loss test, conduct mass-model decoy optical margin tests, and verify release and sever operations using simulated decoy canisters with inert squibs.

Primary heat exchanger load survey testing was completed.

GBU-31 JDAM: Performance testing was completed. Loads testing was completed 25 August 2000. Carrier suitability testing was completed 8 September 2000.

The fifth F/A-18F positive identification system flight was completed on 20 September 2000.

A ground test procedure was developed to assess engine flameout margin and document combustor cycling characteristics. Installed flameout ground tests were completed on aircraft E10 in the "Hush House" on 7 June 2000. Installed flameout screening procedures will be developed for the fleet based on these test results and subsequent data review.

F-14: Digital Flight Control System (DFCS) - In July 2000, on-aircraft ground tests of OFP 4.4 were completed. Flight clearances were received, and an ACLS flight was conducted using F-14D SD 230. ACLS was cleared for use by VX-9 for OPEVAL. The roll stability augmentation system (SAS) evaluation of DFCS version 4.4 software was completed on 5 August 2000. DFCS roll SAS flight testing was successfully completed. The final planned flight in the F-14A DFCS series was completed on 12 September 2000 to evaluate ACLS performance.

ALE-47: LAU-138 B/A regression tests were completed on an ALE-39 configured jet at Oceana. A captive carriage flight and separation flight was flown at NAWCAD Patuxent River, with some anomalies noted.

ALE-47/Airborne Self-Protection Jammer (ASPJ): The modified aft ASPJ rack was built and installed on the test aircraft with no adverse electrical bonding effects shown with the modified installation procedures. Catapult testing was successfully completed on 19 May 2000. Arrested landings for the ALE-47 system and the ASPJ aft rack were completed on 24 May 2000 with no anomalies noted with system performance. Vertical display indicator group (R) E3 ground tests in the anechoic chamber were completed on 14 June 2000, with only the ALE-47 system demonstrating any anomalies.

JDAM: The final enhanced guided test vehicle flight was completed on 16 May 2000.

H-1: Completed functional evaluations for H-1 (GPWS software for the F/A-18) and open system core avionics requirement (GPWS software for the AV-8B), in addition to pilot-in-the-loop evaluations.

KC-130: EMC and TEMPEST tests were completed on the Traffic Alert and Collision Avoidance System (TCAS). Antenna pattern, air data gathering, and Naval Fleet Force Technology Innovation Office (NFFTIO) flights were completed the week of 28 February 2000. Completed NVIS lighting evaluation. In-flight refueling electrostatic discharge/precipitation-static evaluation on LMAero ship S/N 5488 (BuNo 165735) was completed.

CURRENT IMPORTANT PROGRAMS

P-3: Royal Norway Air Force (RNoAF) Upgrade Improvement Program: Evaluation of the radar warning receiver (RWR)/electronic support measures (ESM) system on the Atlantic Test Range was completed and the aircraft returned to Norway. The Test Integrated Product Team completed a dedicated system acceptance test of the RWR/ESM on the fourth, and final, aircraft following further software modification at Lockheed Martin Aircraft Center, Greenville, SC. This testing revealed that the systems were acceptable to commence flight testing on the Atlantic Test Range.

P-3 Service Life Assessment Program (SLAP) Dynamic Loads Survey: Completed dynamic taxi loads, landing impact, and flight buffet testing on 17 February 2000.

USQ-78A Acoustic Hardware and Software Upgrade, Version A4.7A3/D4.P1 Software: Flight testing was completed on 24 February 2000.

EP-3 Sensor System Improvement Program: DT-IIIB was completed and a recommendation to proceed to OT was forwarded in a DT/OT transition report.

P-3C Microwave Radiometer Data Collection: A highly successful polarimetric scanning radiometer, IR (infrared), and hyperspectral data collection detachment was conducted at the Atlantic Undersea Test and Evaluation Center (AUTEC) between 29 April and 5 May 2000. OSD and UK MOD sponsored the project.

P-3C Avionics Improvement Program Standoff Land Attack Missile-Expanded Response (SLAM-ER): P-3C/SLAM-ER functional fit and adjacent stores compatibility tests were completed 23 May 2000.

P-3 Littoral Warfare Advanced Development (LWAD)/Littoral Airborne Sensor Hyperspectral (LASH): The Flight Test Support Team completed five LASH events in support of LWAD 00-2, which took place 2-6 June 2000 off the coast of New Jersey near Hudson Canyon. The LASH project completed every scheduled LWAD flight event, totaling 32.4 flight-hours.

Traffic Alert and Collision Avoidance System (TCAS) antenna test pattern and low-probability-of-intercept altimeter (LPIA) radar flight tests were completed.

All enhanced **Ground Proximity Warning System (GPWS)** and TCAS test flights were completed.

The **Large Area Tracking Range (LATR)** air combat maneuvering P-3C drop/no-drop bomb/mine weapons simulations were successfully tested at the Pacific Missile Range Facility LATR the week of 10 January 2000.

Pioneer Unmanned Aerial Vehicle (UAV): Common Automatic Recovery System (CARS) flight testing was completed on 6 November 1999 by a combined VC-6/VMU-1/NAWCAD team. One final ground test was conducted on 9 November 1999 to finish standard Pioneer-with-CARS efforts. Marine Pioneer aircrew and maintainers from VMU-1 departed on 9 November 1999, following an extremely successful testing period. Testing of the modular integrated avionics group (MIAG)-equipped Pioneer with CARS will take place after completion of basic MIAG tests. Tactical environmental system/freewave radio modem ground tests were successfully completed on 6 March 2000.

CURRENT IMPORTANT PROGRAMS

S-3: Large-scale applique coupon flight tests were completed on 9 August 2000.

Surveillance System Upgrade (**SSU**) phase II testing at Patuxent River was completed 31 July 2000, and shore-based carrier suitability testing was completed on 27 July 2000.

S-3B: All DT was completed in accordance with the S-3B B4.4.3 software verification test plan.

Instrument Flight Rating/Global Positioning System (IFR/GPS) Panel Modification: Two successful flights were completed with the split panel installed on 23 and 24 February 2000.

Communication Improvement Program: The final two combined DT/OT flights were completed on 27 April 2000.

SSU Phase I: Maverick and SLAM seeker video was transmitted real-time from the aircraft to the ground station over the real-time sensor data link.

SH-60: The airborne low-frequency sonar (ALFS) flight test team completed the pre-operational test readiness review (OTRR) on 6 October 1999 and the OTRR on 12 October 1999.

The **MA-16** inertia reel was verified for operational use in the H-60 series aircraft.

SH-60B: Integrated mechanical diagnostics influence coefficients testing was completed. The results will be used in algorithms for SH-60 main rotor track and balance.

Completed EMV and hazards of electromagnetic radiation testing of a new version of the M-299 Hellfire missile launcher.

SH-60R: ALFS mechanical BIT (built-in test) tests were successfully completed.

T-45: Four catapult launches and two arrested landings were completed to evaluate the safe mechanization and operation of the T-45 brake pressure release system. The system worked as intended with the exception of the high gain nosewheel steering mode disengaging at full throw due to relocation of the launch-bar-down proximity switch. Stabilator freeplay envelope expansion testing was completed 9 June 2000, with a permanent fleet clearance for up to .25 degrees freeplay expected.

UH-1N: Miniaturized airborne GPS receiver 2000 E3 testing was completed.

Video display unit EMC, E3, and crew system evaluations were completed.

Gun control unit flight testing was completed on 19 June 2000.

On 27 July 2000, the Human Systems Evaluation Branch completed emergency egress, acoustic, and thermal testing on the UH-3H executive transport. Egress testing was performed with 15 passengers (aircrew and volunteers) exiting from various windows and doors on the aircraft. External acoustic measurements were performed on the new Auxiliary Power Unit (APU) installed atop the starboard sponson. The measurements were made on the APU exhaust through use of a thermocouple array and heat flux sensors mounted on a remotely controlled vehicle.

CURRENT IMPORTANT PROGRAMS

Aircrew procedure trainer (APT) verification was completed.

The **APR-39(V)2 EW** suite was completed.

An **AAQ -22** vibration survey was completed on 16 August 2000.

V-22: The final phase of V-22 OPEVAL at the ACETEF was completed.

VH-3D/60N: OFP Build 7.0D flight testing of fleet assets was completed.

The **Crashworthy Escape Systems Horizontal Accelerator (HA) Team** delivered 10 FMVSS-213 baby seat final test reports to the National Highway Traffic Safety Administration (NHTSA) to meet the end-of-FY99 requirement. The HA, certified as a compliance lab by NHTSA, was the first ever to meet NHTSA's schedule requirements for delivering the most comprehensive reports ahead of schedule. HA team members performed 42 baby-seat tests in 4 months and became certified child safety technicians by conducting an automobile child safety check at the Patuxent River Child Development Center. Additional testing using the HA included establishing a basis for a new triservice safety harness for the mobile crewman.

NAVAL AIR WARFARE CENTER WEAPONS DIVISION

Weapons System Integration: We provide weapons systems/software support throughout the life cycle, including system engineering, system integration, software development, system software verification and validation, configuration management, technology development assessment and application, fleet support, Test & Evaluation support, product line coordination, design/development agent for out-of-production aircraft, and foreign military sales system/software support for the following aircraft: AH-1, AV-8B, F/A-18, F-14, EA-6B, and EP-3.

Weapons Systems and Targets RDT&E: We provide technical agent assistance to the weapons systems and targets acquisition program managers and in-service support for the following weapons and targets: aerial and surface targets, airborne threat simulators, AMRAAM, Evolved Sea Sparrow, HARM, Harpoon, Hellfire, JDAM, JSOW, JSSAM, Maverick, Penguin, Phoenix, Surface Targets, Rolling Airframe Missile, Sidewinder, SLAM, SLAM ER, Sparrow, Standard Missile, and Tomahawk.

Electronic Warfare and Information Warfare Systems: We provide technical agent assistance to the electronic warfare systems acquisition program managers for missile warning systems, IR/EO (infrared/electro-optical) countermeasures systems, radar warning systems, and weapons support systems.

IRCM (InfraRed CounterMeasure) systems, and the Integrated Defense Electronic Countermeasures system.

Test and Evaluation: We provide instrumented open-air land, air and sea test ranges for joint service development and operational test of integrated aircraft/weapons systems and electronic warfare systems, as well as many laboratory and test facilities for warheads, propulsion, and other weapons system components and all-up weapons for both inert and live-fire tests.

CURRENT IMPORTANT PROGRAMS

Fleet Support: In addition to in-service support of weapons and targets, we support Fleet live-fire training and exercises on our land- and sea-ranges; provide science advisors to Fleet commands and support Fleet Battlefield Experiments with planning, evaluation, hardware/software experiments; and provide rapid response to urgent Fleet needs during crises such as Operation Allied Force.

Other RDT&E: Crew systems; weapons support equipment; parachutes; materials research; propulsion/materials exploratory and advanced development product support; targets and simulators for air-, land-, and sea-launched weapons systems; threat simulator development; warheads; fuzes; insensitive munitions; mission planning systems (e.g., TAMPS, JMPS); aircraft survivability and vulnerability live-fire testing; sensor systems; laser/optical systems; nuclear weapons safety; guidance and control systems; foreign military sales support; and operation of land and sea ranges for fleet training.

EQUIPMENT/FACILITIES

AIRCRAFT DIVISION

Patuxent River Station, MD: Facilities include: JSF Grated Hover Pit Air Combat Environment Test and Evaluation Facility (ACETEF), Aerodrome, Air Vehicle, Aircraft Modification and Instrumentation, Aircrew Systems, Test Range Facilities, Avionics, C-7 Catapult MK-7 Arresting Gear and Takeoff Assist, Mission System, Propulsion Systems, Ship and Shore Facilities, Robert N. Becker Laboratory.

JSF Grated Hover Pit - The Patuxent River Hover Pit, located adjacent to Taxiway C at center field, is designed for hover flight operations and high-power tie-down runs of Vertical Short Takeoff and Landing (VSTOL) aircraft. The pit dimensions are approximately 100 ft x 153 ft x 10 ft (WxLxD), with a gridded useable surface area approximately 96 ft x 96 ft. The gridded area of the pit contains a matrix of grating suitable for aircraft tires, and cascade vanes designed to turn the exhaust flow toward the exit of the pit. The design objective of the pit is to minimize Hot Gas Ingestion (HGI) and fountain development and to approximate "Out of Ground Effect" (OGE) conditions. The structural design criteria for the Patuxent River hover pit far exceed the requirements to support AV-8B pit operations. The pit was designed to support the X-32 and X-35 tie-down, hover, Vertical Take Off (VTO), and Vertical Landing (VL) operations at 35,000 lb at up to 600 fpm rate of descent (ROD) and future VSTOL aircraft test requirements.

Air Combat Environment Test and Evaluation Facility (ACETEF) - The ACETEF is a fully integrated ground test facility that allows full spectrum T&E of highly integrated aircraft and aircraft systems in a secure and controlled engineering environment. The facility uses state-of-the-art simulation and stimulation techniques to provide test scenarios that reproduce the conditions of actual combat. In ACETEF, a fully integrated weapon system, incorporating vehicle, avionics, weapons, crew, other platforms, and critical elements of the operational command/control hierarchy is immersed in a virtual warfare environment. Aircraft systems are stimulated through a combination of simulation by digital computers and stimulation by computer controlled environment generators that provide radio frequency (RF), electro-optical (EO), and laser stimuli that duplicate real signals as closely as possible. The flight crew is provided very high fidelity visual, aural, and tactical workload conditions (threats, mission objectives and constraints, communications channels, etc.).

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ACETEF permits ground testing of fully integrated avionics systems in an environment that closely parallels actual combat. The data gathered by ACETEF augments that available from conventional flight testing in three ways. First, ACETEF reproduces the conditions encountered during a test flight, allowing systems engineers to study a problem under controlled conditions. Second, ACETEF subjects systems and crews to conditions that cannot be reproduced in actual flight short of real combat. Finally, ACETEF testing is secure; it cannot be witnessed by uninvited observers. The ACETEF is linked to other facilities aboard NAWCAD Patuxent River. A directional microwave link exists between the facility and the Shipboard Ground Station (SGS), allowing a Light Airborne Multipurpose System (LAMPS) MK III helicopter to be subjected to simulated combat conditions within the ACETEF, while simultaneously stimulating the LAMPS MK III shipboard combat suite at either the SGS FFG-7 (guided missile frigate) installation, or (via the SGS-Chesapeake Test Range-Wallops microwave data link (MDL)) the Aegis Test Suite at NASA Wallops. The Chesapeake Test Range-ACETEF link allows a downlink of test aircraft flight data to drive the cockpit at the Manned Flight Simulator (MFS), duplicating the flight conditions in the lab in real-time. Alternatively, this link allows a simulator "flight" to be monitored at the Chesapeake Test Range as if it were an actual flight.

ACETEF components include:

- Operations and Control Center
- Advanced Manned Flight Simulator
- Aircrew Systems Evaluation Facility
- Electronic Warfare Integrated System Test Laboratory
- Threat Air Defense Laboratory
- Offensive Sensors Laboratory
- Communications, Navigation, and Identification Laboratory
- Shielded Hangar
- Aircraft Anechoic Test Facility
- Electromagnetic Environment Generating System.

Operations and Control Center (OCC): The OCC is the focal point for all ACETEF integrated T&E activities. It provides central command and control for test execution and is designated lead laboratory for ACETEF tests. OCC also operates the Simulated Warfare Environment Generator (SWEG), a primary combat simulation system, which generates threat scenarios.

Advanced Manned Flight Simulator (MFS): The MFS was designed as a tool for flight test engineers and pilots to evaluate avionics and flight control systems evaluations in a man-in-the-loop environment. The aircrew is provided with the appropriate visual, aural, and motion cues from the synergistic six-degrees-of-freedom motion system to simulate actual flight in a combat environment. The MFS facility includes high fidelity simulations within fleet representative cockpit models such as the F/A-18, F-14D and V-22 aircraft. Multi-reconfigurable cockpits are available for emulating the cockpit/displays of the F/A-18, F-14, X-31, T-45, EA-6B, UAV, AH- 1W, H-60, E-2C, V-22 and AV-8B aircraft. Four simulation stations (two high-fidelity and two low-fidelity) are available. Three simulations can be run simultaneously.

Aircrew Systems Evaluation Facility (ASEF): The ASEF provides the facilities necessary to evaluate the man-machine interface and the aircrew workload during ACETEF testing. Additionally, the ASEF rapidly prototypes cockpit displays and layouts, control panel display formats, and aircrew interfaces.

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Electronic Warfare Integrated System Test Laboratory (EWISTL): EWISTL is an on-line, open loop, radio frequency (RF) generating facility used primarily to stimulate aircraft electronic warfare (EW) systems. EWISTL can gauge the performance and integration of EW systems within their avionics packages against simulated hostile conditions. The facility can simulate up to 1024 threat radar systems simultaneously. These radar systems can be located on up to 256 moving platforms to simulate surface combatants, aircraft, or missile systems. Types of systems recently tested include radar warning receivers, defensive electronic countermeasures (ECM), electronic support countermeasures, laser warning receivers, missile approach warning systems, and expendable controllers.

Threat Air Defense Laboratory (TADL): The TADL provides closed loop hardware and man-in-the-loop hybrid simulations of specific threat radar systems to a very high level of fidelity. The simulations are used to determine ECM effectiveness, including radar tracking errors and missile miss distance.

Offensive Sensors Laboratory (OSL): The OSL provides multi-spectral stimulation of the aircraft's offensive sensor suite and smart weapons. The facility is being upgraded to include an air-to-air and air-to-ground radar stimulator, infrared target generator, radar and infrared missile stimulators, and laser missile stimulator.

Communications, Navigation, and Identification Laboratory (CNIL): CNIL is an independent laboratory within ACETEF which provides the capability for hardware-in-the-loop testing of actual Communications, Navigation, and Identification (CNI) systems, as well as the capability to simulate numerous CNI equipment's for realistic system level testing. The facility generates actual RF signals that can be directly coupled into a single system under test or radiated in the anechoic chamber environment. The CNIL is coupled with a threat generation software package to generate RF signals that simulate the command and control communications of the threat environment.

Electromagnetic Environmental Effects Division Facilities: The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) test facility is the shielded hangar complex. It provides an isolated electromagnetic environment (EME) for inter/intrasystem testing of the total aircraft. The electromagnetic pulse (EMP) simulation facility consists of a horizontal center-fed dipole and vertical monopole base-fed antennas. These antennas provide the capability to perform EMP vulnerability testing on aircraft. The Lightning/Electrostatic Discharge (ESD) facility has high voltage and high-amperage generators that provide capabilities to test effects of, and protection from, lightning strikes. This facility also houses Precipitation Static (P-Static) testing capabilities. The Test for Electromagnetic Propagation and Evaluation for Secure Transmission (TEMPEST)/Communications Security (COMSEC) Laboratory contains a full suite of automated test equipment. It is capable of communicating with aircraft and land-based stations in the HF, VHF, and UHF ranges. The capabilities and built-in flexibility of the facility have been instrumental in the research, development, and operational testing of new and modified secure communication equipment and systems.

Shielded Hangar: The Shielded Hangar serves as the central hub for all Electromagnetic Environmental Effects (E 3) testing at NAWCAD Patuxent River. This facility provides an RF quiet environment for a myriad of E 3 technology testing, including Intra/Intersystem EMC, Emission Control (EMCON), Lightning/P-Static/ESD, TEMPEST/COMSEC, and avionics conformance testing. The hangar is capable of providing in-flight test simulation/stimulation for avionics, flight controls, weapons testing, and aircraft maintenance when required.

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Aircraft Anechoic Test Facility (AATF): The Anechoic Chamber provides a secure and realistic test environment for system stimulation. The Anechoic Chamber laboratories provide a multispectral stimulation and simulation environment for the aircraft and its systems that closely resemble actual combat. AATF is a tactical aircraft size anechoic chamber which provides an ultra-quiet, secure RF environment to simulate realistic free-space flight. The test area is 96 feet long, 60 feet wide, and 30 feet high. A traveling hoist will accommodate test objects up to 30 tons in weight. The AATF is a focal facility for the ACETEF laboratories and provides an ideal environment for integrated systems testing.

Electromagnetic Environment Generating System Laboratory (EMEGS): The EMEGS Laboratory provides simulation of high-intensity electromagnetic environments. This ACETEF component simulates the world-wide Fleet Operational EME and evaluates effects on an aircraft's critical functions, mission systems, and vehicle systems. These evaluations are intersystem EMC, high-intensity radiated fields (HIRF), or Electromagnetic Radiation (EMR) tests. Since EMEGS is transportable, testing can be performed indoors on the deck of the shielded hangar or in the anechoic chamber, or outdoors on the Naval Electromagnetic Radiation Facility (NERF) ground plane adjacent to the shielded hangar parking apron.

Aerodrome: RDT&E aviation capabilities provided by aircraft, hangar facilities, maintenance, runways and airfield services. Enables the conduct of flight, ground and ship-based aircraft RDT&E.

Air Vehicle RDT&E Facilities: Provides RDT&E for air platforms with armament and stores, component systems and hardware support systems. Conducts research and development for naval airframes and air vehicle subsystems.

A Component Laboratory is:
Robert N. Becker Laboratory: Consists of 23 state-of-the-art laboratories. The extensive fabrication, processing, test, and evaluation capability that exists in these laboratories supports many division projects, as well as the Naval Aviation Systems Team and the Fleet. These facilities provide a capability for the complete synthesis and characterization of existing and advanced materials and new materials concepts. Maritime environment simulation and characterization are emphasized. The 65,000 square foot Aircraft Technologies Laboratory, which began operations in the summer of 1995, supports Materials R&D efforts, and includes Polymer, Composites, and Coatings laboratories.

Aircraft Modification & Instrumentation Facility: Provides test laboratories and shop support facilities for engineering, technical documentation, test instrument development and fabrication, verification tests, calibration support, maintenance of instrumentation/measurement standards, and instrumentation software and hardware development. Laboratory instrument and calibration facilities support peculiar and general purpose electronic test equipment for all fleet and DT&E/OT&E activities at NAWCAD Patuxent River. Transducer, accelerometer, fluid flow, pressure and microwave frequency calibration systems are configured to interface type II and III calibration standards directly with aircraft systems. A strain gauge and structural analyses laboratory provides the capability to install and calibrate strain gauge instrumentation utilized in measuring aircraft loads during fixed and rotary wing aircraft flights. Mechanical design and fabrication facilities provide support to RDT&E and OT&E instrumentation and test project installations and fleet support requirements. Capabilities include computer-aided design (CAD)/computer-aided manufacturing (CAM), computerized structural analyses, traditional metal working, precision machining, all types of welding, fiberglass fabrication and

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composite material repair. The NAVAIR Special Flight Test Instrumentation Pool (SFTIP) was established to eliminate long lead time for acquisition of specialized airborne test instrumentation and to promote standardization.

Aircrew Systems RDT&E Facilities: The Aircrew Systems Test Facility includes nine laboratories which provide the capabilities required for T&E of escape and survival systems, aircraft environmental/electronics systems, life support systems, fluid flow and gas systems, Vertical Takeoff and Landing (VTOL)/Vertical Short Takeoff and Landing (VSTOL) downwash, human factors/man-machine interface factors resulting from the integration of all the mechanical, avionics, and environmental sub-systems of the total aircraft, internal and external lighting, and night vision systems.

Component laboratories are:

- Escape and Survival Systems Laboratory
- Environmental/Electronics Laboratory
- Life Support/Fluid Flow and Gas Laboratory
- Mobile VSTOL Downwash Laboratory
- Crewstation Technology Laboratory
- Crew-Systems Integration Laboratory
- Aircraft Lighting Laboratory
- Human Factors Test and Evaluation Laboratory
- Night Combat Test Laboratory.

Escape & Survival System facilities and equipment provide capabilities for test and evaluation of assembly, disassembly, inspection, and operation procedures of escape and restraint systems in normal and adverse operational conditions. Human factors facilities and equipment provide capabilities for test and evaluation of the design and operation of aircraft systems concerning the ease of maintenance and operation, efficient safe procedures, control-display relationships, man-machine interface, crew station lighting, crew accommodation, anthropometry, vision and task performance.

Atlantic Ranges The Chesapeake Test Range facilities provide aircraft tracking, data acquisition and relay, range surveillance, targets and communications/control of multiple aircraft test events in the Chesapeake Bay and, via a microwave data link (MDL), in the Atlantic Warning Areas. An integrated network of cinetheodolites, laser, and radar trackers along the western Chesapeake shore are linked to computation and control facilities at NAWCAD Patuxent River. The MDL with NASA Wallops Flight Facility (WFF) permits utilization of NASA precision radars in the Atlantic Warning Areas and relay of telemetry to NAWCAD Patuxent River. Multi-object trilateration tracking and four differential GPS receivers provide TSPI for multiple air/surface test vehicles. Special purpose instrumentation includes radar for EW systems simulation, videographic and photographic instrumentation, mobile instrumentation, and instrumentation for shipboard test of aircraft. Air/Surface seaborne targets, short-range missile fire areas, direct fire areas and sonobuoyd rop areas are integrated with range facilities. Range tracking and target data are integrated in the range computation and control center which then provide space position, EW data link, and meteorological data to the Real Time Telemetry Processing System (RTPS) for correlation with aircraft telemetry data. Area frequency coordination for the Mid-Atlantic Area is performed, which includes coordination/scheduling of frequency assignments for test operations and shared RF usage in the 3 MHz to 35 GHz spectrum. Major testing capabilities include surface targets, aerial targets, subsonic and supersonic air space and operating areas to support a wide variety of aircraft weapon systems testing. Major test functions include Flying Qualities and

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Performance (FQ&P), weapon separation and delivery system performance, aircraft installed avionics performance, aircraft and mission systems performance, aircraft propulsion system flight tests, aircraft carrier suitability and ship dynamic interface testing.

Microwave Facility: The Microwave Facility operates several MDLs, a Wallops Link, a Webster Field Link, and a Laser Site Link. The Wallops Link is a two-repeater hop, each of which receives and retransmits data. The link travels from NAS Patuxent River to Bishops Head, to Crisfield (the current leased facility), to Wallops. It is used to relay data from NAWCAD Patuxent River test operations conducted over the Atlantic Ocean using Wallops radar and telemetry tracking systems. Additionally, the LAMPS MK III program uses the link to access the Navy Aegis facility assets at WFF. The Webster Field Link is a one-repeater hop from NAS Patuxent River via the Hermanville repeater site to OLF (Outlying Field Activity) Webster Field.

Time Space Position Information System Facilities (TSPI): TSPI Systems measure position, acceleration, attitude, and rates of change of airborne and surface targets as a function of time. TSPI data is obtained by using radar, electro-optics, video, film, laser, multilateration using Extended Area Tracking System transponders, and/or GPS. The TSPI information from all sources is integrated in the range control center where the data is processed and displayed in real-time and recorded for post mission processing or playback. The division also provides geodetic survey using traditional and GPS techniques, and maintains and operates meteorological instrumentation for collecting and providing atmospheric data as required for test operations.

Real-Time Avionics Flight Test Facility: The Real-Time Avionics Flight Test Facility, located within the Chesapeake Test Range, is responsible for evaluating in-flight aircraft avionics performance at the component level. This facility stimulates receiving and transmitting avionics equipment on an aircraft, with the equipment in its intended operating environment. The stimulation effects can be observed in real time. The facility also has subsystems that can be programmed or configured to support a variety of tests and multi-user requirements, providing an efficient and cost-effective use of simulation and stimulation assets.

Capabilities of the facility include:

- Computer Controlled Programmable RF Emitter Simulations (Generic, Threat, Friendly) of up to 134 simultaneous RF emissions
- Up to 32 Simultaneous Communication, Control and Coordination emitter simulations with diversity in antenna beam shapes, scan patterns, output power levels, modulation techniques, and geographic location
- In-flight Radar Cross Section (RCS) measurement and analysis
- EW avionics tests including: antenna patterns, direction of arrival, receiver performance, jammer technique analysis, and Jammer-to-Signal ratios shown against chaff and decoys. The Real-Time Avionics Flight Test Facility mission is directed both toward evaluations of internal aircraft avionics at the component level, as well as toward evaluations of the aircraft's radar return characteristics, such as RCS measurements.

Remote Electronic Warfare Site (Point Lookout): The Metric and TSPI Division operates a Remote EW site at Point Lookout, Maryland. This EW facility is used mainly to achieve spatial diversity of emitters during EW tests. It is also used for surveillance radar and range clearance. By using the facilities at Point Lookout in conjunction with those at NAWCAD Patuxent River, an aircraft's ability to

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discern two signals from two different directions can be evaluated. Additional testing is performed by filling the airspace with many electromagnetic signals, and trying to stress the aircraft's systems. Current testing on the EA-6B utilizes the EW facility to radiate signals for threat simulation. NASA WFF, Virginia. Seaborne targets consist of fixed target arrays, remote-controlled boats and ship hulks. Land targets include manned and remote-controlled ground vehicles and fixed targets. All targets are tailored for the needs of a particular test project by installation of applicable target augmentation devices including visual enhancement, radar, infrared, or acoustic emitters.
Specific services provided include:

- Telemetry surveillance
- Divers for test item recovery
- Target maintenance and repair
- Real-time impact scoring
- Laser designator operations
- Design and fabrication of targets.

Avionics RDT&E Facilities: Provides RDT&E for the full spectrum of avionics systems. Included are aircraft and antenna towers, as well as RDT&E capabilities involving electro-optics and reconnaissance, electric systems, navigation, antenna systems, communications, radar, computer and electronic sensors.

C7 Catapult, MK7 Arresting Gear and Take-off Assist Facility: Test facilities include a C-7 catapult upgraded to a C-13 Mod 0 catapult capability, MK-7 Mod 3 arresting gear, and a configurable take-off assist ramp, all of which are representative of shipboard installations. The facilities are fully instrumented with optical and electronic measurement equipment for real-time and post-flight analysis of all desired aircraft and launch/arrest/ramp performance parameters, including structural loads and acceleration effects on airframes and related subsystems.

Mission System RDT&E Facilities: Provides RDT&E capabilities for C41, Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), AEW, Tactical, VP, VS and Vertical Flight Mission areas. Includes software development and hardware integration support facilities.

Propulsion Systems RDT&E Facilities (PSEF): The Propulsion Systems RDT&E Facilities is the only Navy Facility which provides the complete range of testing, development, reliability and fleet service engineering support for fixed and rotary wing air vehicle engines, engine components and accessories; and test and evaluation services for small engine air-breathing propulsion systems, power drive systems, fuels and lubrications. The PSEF was recently completed to house propulsion and test functions relocated to NAWCAD Patuxent River from NAWCAD Trenton. This facility houses the following activities:

- Rotor Spin Facility
- Helicopter Transmission Test Facility
- Unmanned Aerial Vehicle Altitude Test Cell for testing small reciprocating and turbine engines
- Fuel System Component Test Facilities
- Fuels and Lubricants Test Cells
- Fuels and Lubricants Analytical Laboratory
- Aircraft Engine Emission Test Laboratory
- High Volume Fuel Flow Facility.

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Ship and Shore Electronic Systems RDT&E Facilities: Provides RDT&E for Air Traffic Control systems, Identification (ID) systems, Special Warfare (SPECWAR), communication, shipboard data link, & systems external communications. This facility includes: Identification Friend or Foe (IFF) Systems, LAMPS and Ship Data Link, Ship Combat and Communications Systems, Special Warfare/Joint Interoperability and Information Technology.

NAWC-WEAPONS DIVISION

Missile And Aircraft Weapon Software Support Activities (WSSA). The Weapons Division is home to six WSSAs: F/A-18, F-14, EA-6B, AV-8B, AH-1, and the EP-3. The WSSAs provide development testing; verification and validation; safety-of-flight testing; quick-response investigations of problems reported by the Fleet; corrections of errors and deficiencies; investigation of changes; life cycle weapon-system support; and integration and testing of new technology, mission systems, and weapons. Some WSSAs perform software design, coding, and development. The WSSAs integrate yesterday's weapons on new generation aircraft as well as integrating advanced mission systems and weaponry on legacy aircraft.

Integrated Battlespace Arena (IBAR). IBAR is an advanced simulation facility. The elements of the IBAR are joined with each other and are also connected through various media-fiber optic, Secret Internet Protocol Router Network (SIPRNET), ethernet, microwave, telecommunication-with ranges and facilities throughout the U.S. and worldwide. Customers can use the services of a single arena element, a combination of elements, or a national integrated network of simulation capabilities.

Virtual Prototyping Facility (VPF). The VPF is an all-digital cockpit environment readily configurable to emulate most fighter/aircraft in which weapon designers can address critical system interactions between aircraft and weapon systems. The VPF offers one-on-one and one-on-many aircraft engagements for manned and unmanned aircraft. The VPF is networked with a growing number of similar facilities around the country.

Precision Engagement Center. Two specialized labs make up this facility. The Imagery Exploitation and Support Lab provides imagery and intelligence expertise and products for weapons designers and operational forces. The lab addresses the imagery-dependent requirements of emerging weapon systems and Navy C4I planning systems by providing collection management services; controlled image archives; mapping, charting, and geodesy data; and expert image exploitation and manipulation. The Strike Planning and Rapid Targeting Lab is representative of a Navy C4I planning and targeting facility and replicates many of the support systems within the Aircraft Carrier Intelligence Center.

EO/IR (Electro-Optical/Infrared) Systems Evaluation Laboratory. This lab excels in the reverse engineering, analysis, evaluation, and simulation of threat systems. The lab provides highly accurate and detailed threat simulations to the IBAR's VPF, so users are assured of the highest level of threat simulation.

Navigation Laboratory (NavLab). The NavLab supports distributed integration testing of GPS receivers through the ethernet. Customers drive the GPS simulator from their site with 6-DOF (Six-Degrees-of-Freedom) data and obtain positional and spatial data from the NavLab GPS receiver. The NavLab supports navigation performance analysis and operates several differential GPS reference stations. The state-of-the-art lab also supports inertial navigation system (INS) performance analysis and

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characterization.

IR Scene Presentation Laboratory. Hardware-in-the-loop (HWIL) and signal processor-in-the-loop (SPIL) synthetic IR environments are created in this lab and are used to test the Navy's most advanced seekers. The lab offers calibration and verification for IR projection technologies.

Real-Time Hardware-in-the-Loop (HWIL) Laboratory. In anechoic chambers equipped with flight-motion simulators, engineers test actual hardware-subcomponents, components, and systems in an environment that accurately simulates missile flight. The RF and IR chambers are capable of sophisticated target presentation, both through signal injection and scene projection. Real aircraft avionics can also be incorporated and, through a fiber-optic link to the F/A-18 Advanced Weapons Laboratory, a pilot in an operational cockpit can further expand the simulation. When testing inertial navigation systems, the lab can supply the system under HWIL test with data directly from the NavLab. Similarly, when testing an IR system, the IR Scene Presentation Laboratory is the source of equal-to-real-world target imagery. The lab also features a Carco five-axis flight simulator and integrated IR target-presentation system that have an off-boresight capability greater than 90 degrees. This capability is invaluable in HWIL testing for the advanced missile seekers.

Dual-Mode Laboratory. The versatility of the dual-mode seeker-which operates in both the IR and RF regions presents a challenge for all-up full system testing. The Dual-Mode Laboratory meets this challenge and allows end-to-end testing of the weapon. Thus in one place, at one time, the dual-mode seeker can fly a complete mission, from launch to terminal encounter.

Mission Planning Facility. In this facility, NAWCWD engineers have created a unique, Fleet-representative, warfare-planning environment to help integrate advanced capabilities into the Navy's mission-planning community. The facility supports the development, test, prototyping, and validation phases of new mission-planning capabilities with a focus on "system of systems" concepts. The environment is conducive to mission rehearsal and playback as well as to "what if" analysis.

High Performance Computing Distributed Center (HPCDC). Additional computational horsepower for the IBAR is supplied by the on-site HPCD, the newest of 15 such Centers funded by the Department of Defense. The HPCDC contains more than $4 million in state-of-the-art computing resources including two Silicon Graphics Reality Monster Bases (32 processors total) and an Amherst Systems digital output processor and associated software.

Interoperability Test & Experimentation Complex (ITEC). The ITEC links C4I systems for warfighter test, training, and experimentation events in a controlled, closely monitored operational environment. The ITEC creates theater-level environments and dynamics by linking synthetic applications (live, constructive, and virtual) on various interconnected network infrastructures. As well as receiving live and simulated object tracks from other ranges, labs, and facilities, the ITEC supplies other ranges, labs, and facilities with live and simulated object tracks from the Sea Range. The ITEC consists of a fixed-site facility at Point Mugu as well as local and remote electronic and communications systems and the expertise necessary to coordinate, manage, and support complex operations and experiments.

EQUIPMENT/FACILITIES

Radar Cross-Section (RCS), High Power Microwave (HPM) Measurement, And GPS Jamming Facilities: Etcheron Valley is an outdoor research facility for RCS testing, HPM measurements, and GPS jamming tests. The facility offers excellent air and ground security. The facility provides the instrumentation suite, test coordination, targets, facilities, and support functions.

Missile Engagement Simulation Arena (MESA): The only facility of its kind in the world, MESA is a large indoor facility used to evaluate sophisticated interactions between air vehicles and missile sensors. Missile lethality, air-vehicle survivability, and endgame properties of both sensor and vehicle can be analyzed in a cost-effective alternative to field-testing. Targets weighing up to 25,000 pounds are suspended and accurately oriented in yaw, pitch, and roll angles. The sensors up to 200 lbs are transported past the target at selectable speeds and orientations. Typically, thousands of intercepts are simulated during a system evaluation, providing more precise data than obtained from a missile firing.

Energetic Materials Laboratories. A complex of laboratories provides facilities for energetic materials research in the fundamentals of propellant and explosives technology. Outdoor warhead test arenas are capable of testing up to 500,000 pounds of explosives:

Ordnance and Propulsion Pilot Plant. The 56-building facility is designed exclusively for proper handling of energetic materials from synthesis of new energetic materials and new formulations and extends from hand mixes to large-scale processing of propellants and explosives.

Detonation Physics Laboratory. Highly instrumented firing bays allow detonation of up to 15 pounds of explosive. This laboratory has ultra-high-speed framing and streak cameras as well as electronic instrumentation to fully characterize detonation reactions.

Air-breathing Propulsion Facility. Facilities perform instrumented static-fires and tests of air-breathing engines such as ramjets, scramjets, pulse detonation engines, divert bi-propellant propulsion, and expendable turbine systems as well as engine components such as fuels, inlets, insulators, combustors, fuel-management systems, and pyrotechnic devices. Multiple test bays are available for cold flow and hot firings of liquid- and solid-fuel systems.

Skytop Propulsion Complex. This facility performs static testing and characterization of solid-fuel rocket motors, from small motors and gas generators to rocket motors with 1.5 million pounds of thrust. The isolated instrumented test areas and facility designs enable testing of large, high-energy, high-risk systems with complete protection for personnel and minimum equipment exposure.

Plume Measurement Facility. This facility gathers rocket motor performance measurements and signature-characterization data for rocket plumes, providing information to designers of weapons and countermeasures. Rocket motor test stands up to 20 feet high, accommodate motors up to 30 inches in diameter and 14 feet long and with thrusts to 80,000 pounds.

Non-Destructive Ordnance Test Facility. This facility uses a large, high-energy computed tomography system; two-dimensional digital video data; and conventional film x-rays to inspect tactical missile systems for non-destructive testing, lot acceptance, quality assurance, environmental qualification, safety testing, and explosives and propellant research, development, test, and evaluation.

EQUIPMENT/FACILITIES

Aeroheat Test Facility. This facility (T-Range) is a high-pressure air blow-down facility capable of simulating variable Mach number and altitude flight conditions for materials characterization and testing of tactical-sized missile components and air-breathing propulsion systems. Infrared imaging cameras are available to estimate the surface temperature on items being tested.

Composites and Plastics Laboratory. This laboratory provides advanced composite development, from design and analysis methodology, materials development and characterization, and fabrication methods, through testing for tactical missile airframes and propulsion systems. The plastic and composite (fiber-reinforced) parts developed here include bulkheads, complete airframes and nozzles, liners and insulators, and rocket-motor cases.

Radar Reflectivity Laboratories

Monostatic Radar Reflectivity Laboratory. This facility has two instrumented anechoic chambers. The larger chamber is equipped for performing electromagnetic scattering and radiation measurements to determine radar signatures of air vehicles as large as 16 feet and weighing up to 2000 pounds. The chamber is polarization diverse and can measure S, C, X, Ku, Ka, V, and W bands. The second chamber is used primarily for development and testing of antennas and target-augmentation devices. This smaller chamber can provide monostatic near-field measurement data over the 2 to 95 gigahertz.

Bistatic Radar Reflectivity Laboratory. A one-of-a-kind facility that consists of a large instrumented anechoic chamber for performing bistatic electromagnetic scattering and radiation measurements to determine radar signatures of air vehicles as large as 30 feet and weighing up to 6000 pounds. The facility that provides free space, far-field or near-field conditions in a secure indoor environment. The facility is polarization diverse and is instrumented to measure 0.1 to 100 gigahertz.

Optics and Laser Research Facility. Laboratories and equipment in this facility provide the capability for design, fabrication, characterization, evaluation, and research of new optical materials. Specific areas of research include laser devices, laser interaction with matter, and protection against laser radiation. Capabilities include diamond turning, optical thin films, optical characterization, laser devices and effects, laser spectroscopy, and large optics.

Information & Electronic Warfare (I&EW) Systems Laboratories. These labs provide life cycle support for airborne EW systems, including warning receivers, jammers, EO/IR, missile-warning, countermeasures, and support systems; software support for the EA-6B aircraft as well as for prime multi-platform EW systems; and system engineering support, including system design and integration, development of information systems, and fleet system software upgrades for warning, jamming, and decoy systems.

Weapons Survivability Laboratory (WSL). The WSL conducts survivability testing to provide empirical data on the vulnerability of aircraft to actual threats. Survivability tests at the WSL are conducted on operating aircraft and subsystems to smaller-scale developmental hardware, simulators, replicas, components, and materials. Airflow, simulating localized in-flight conditions, can be provided up to 600 knots. Ballistic testing is performed with a broad spectrum of threat munitions ranging from small arms to full missile warheads. WSL test instrumentation is comprehensive, and a variety of data products are offered. On-site services include a complete machine shop and mechanical, aerospace, and electronic engineering support.

EQUIPMENT/FACILITIES

Aerial And Surface Targets Complex. This complex provides full life cycle support services for aerial and surface targets. Services include target development, modification, test and evaluation, operations, maintenance, and the associated systems and in-service engineering functions. Target augmentation/auxiliary systems, which are available for all aerial and surface target types, include command-and-control, flight termination, radar and infrared signature enhancement, threat seeker and threat countermeasure simulators, and scoring systems.

Land Ranges. The remote and secure Land Ranges are composed of multiple air and ground test ranges, specialized test areas, ordnance test facilities, and control and support facilities. The ranges support T&E and training for aircraft systems, air-to-air and air-to-surface missiles, rockets, bombs, cluster munitions, cruise missiles, unmanned air vehicles, guns and artillery, fuzes and sensors, mass detonation, training and tactics development, and parachute systems. Instrumentation is complete and modern. Training range areas represent a typical wilderness combat environment and presents pilots with realistic conditions not duplicated at other ranges for delivery of training ordnance, T&E of new and experimental systems, search-and-rescue training, helicopter mobile assaults, and insertion, firefights, and extraction.

Sea Range and San Nicolas Island. This range, off the coast of Pt. Mugu, CA, is the US's largest, most heavily instrumented military T&E and training sea/air range. San Nicolas Island (SNI) has a 10,000-foot runway and an impact area for weapons launched from aircraft or ships. Aerial and sea targets are available. Electronic warfare environments are provided by manned aircraft, unmanned aerial targets, and surface assets. Cruise missiles can be launched from the Sea Range and flown to ranges in CA, NV, or UT.

Electronic Combat Range (ECR). The ECR is a remote and secure free-space (open-air) test range used for the development of airborne EW systems and techniques designed to sense, counter and/or penetrate threat air-defense systems. About 20 land and naval threats are located on the range for engineering, testing, analysis and training as well as for the testing of expendables and decoys.

National Parachute Test Range. This range provides a broad spectrum of resources and capabilities for parachute testing. These include parachute fabrication, airborne and ground-based instrumentation, sled track operations, aircraft, live jumpers, water test areas, explosive operations, and paraloft facilities.

Naval Test Wing Pacific (NTWP). The NTWP provides aircraft, project flight-test aircrews, flight-test planning, and flight-clearance management and aircraft modification to support weapons and weapon-systems development, test and evaluation, and training missions. These services can be deployed world-wide. Two Weapons Test Squadrons make up the NTWP, one at Point Mugu and one at China Lake.

Airfields. Airfields at China Lake, Point Mugu, and San Nicolas Island provide comprehensive flight services for NAWCWPNS customers. These airfields can support all types of tactical and logistical aircraft (including C-5s and 747s) and offer a full range of airfield operational capabilities and related facilities for support of research, development, test, and evaluation projects.

Test Track Facilities. The 21,600 foot Supersonic Naval Ordnance Research Track (SNORT) can provide sled speeds up to 5,000 fps and can handle test items of up to 136,000 lbs including sled. The 3,000 foot G-4 Track is located 500 feet above a dry lake which allows free-flight ballistic launch

EQUIPMENT/FACILITIES

trajectories. Both tracks provide a relatively instrumented inexpensive and repeatable dynamic environment for testing.

Virtual Missile Range (VMR). The NATO SeaSparrow Missile VMR uses a variety of facilities, hardware and software at Point Mugu and San Nicolas Island to simulate radars, fire control systems, targets and missiles to provide ships on the Sea Range with simulated engagement scenarios that appear real to the ships sensors and personnel. Details describing the engagement are sent to the ship, just as if a live-fire engagement had transpired, but without the need for target and missile allocation.

Naval Ship Weapons Test Facility. Located at White Sands Missile Range (WSMR) in New Mexico, this range performs assembly and live-fire testing of surface-to-air, surface-to-surface weapons, and research rockets. Major facilities include the Desert Ship, Missile Assembly Facility (MAF), research rocket launch complexes, and other firing complexes for testing advanced gun munitions, targets, and short-range missile systems. These facilities, integral to WSMR, provide highly instrumented land and airspace, and are configurable to meet weapon pre-launch, initialization, launch and in-flight requirements.

Naval Air Warfare Center
Patuxent River, MD 20670-1547
(301) 757-7825

Commander, NAVAIR: VADM Joseph Dyer
Deputy Commander, NAVAIR: Dr. Alan Somoroff

*FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	3.300	N/A	0.000	3.300
6.1 Other	1.937	N/A	1.674	3.611
6.2	33.000	N/A	23.140	56.140
6.3	29.990	N/A	34.275	64.265
Subtotal (S&T)	**68.227**	N/A	**59.089**	**127.316**
6.4	71.581	N/A	41.382	112.963
6.5	108.986	N/A	129.362	238.348
6.6	259.188	N/A	130.888	390.076
6.7	99.164	N/A	119.602	218.766
Non-DOD	0.000	N/A	0.000	0.000
TOTAL RDT&E	**607.146**	N/A	**480.323**	**1087.469**
Procurement	357.911	N/A	419.930	777.841
Operations & Maintenance	345.246	N/A	271.598	616.844
Other	236.302	N/A	204.196	440.498
TOTAL FUNDING	**1546.605**	N/A	**1376.047**	**2922.652**

*MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.103

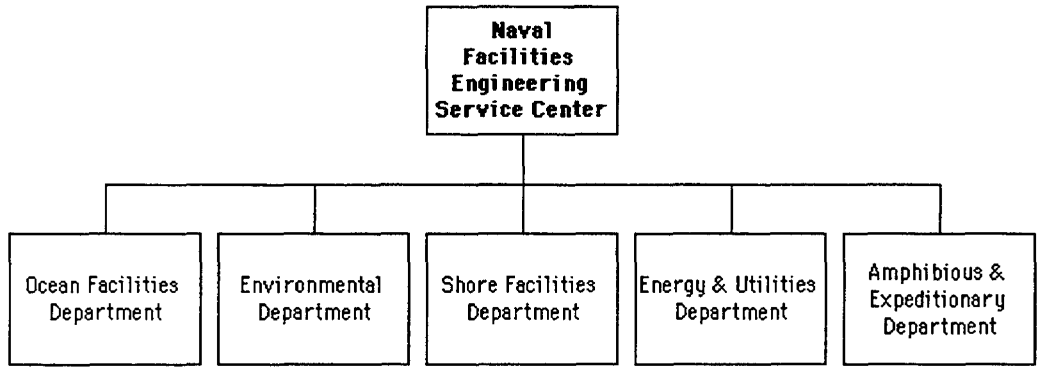
*PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	**SCIENTISTS & ENGINEERS**		**TECHNICAL SUPPORT & OTHER PERSONNEL**	**END STRENGTH**
	DOCTORATES	**OTHER**		
MILITARY	2	212	1599	1813
CIVILIAN	197	3762	5003	8962
TOTAL	**199**	**3974**	**6602**	**10775**

*SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	6750.787	**REAL PROPERTY**	1416.323
ADMIN	799.308	** NEW CAPITAL EQUIPMENT	28.385
OTHER	5759.201	**EQUIPMENT**	515.606
TOTAL	**13309.296**	** NEW SCIENTIFIC & ENG. EQUIP.	12.032
ACRES	**1136307**	** Subset of previous category.	

** As a result of applying the In-House RDT&E Activity criteria at the division or major site level (see NOTE on page 3-1), NAWC Training Systems Division and NAWC Aircraft Division Lakehurst Activity data is not included in the FY2000 report. The additional business base contributed by these two activities is $1.13B for Training Systems Division and $0.52B for Lakehurst.*

Naval Facilities Engineering Services Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Naval Facilities Engineering Services Center
Port Hueneme, CA 93043-4328
(805) 982-1393

Captain: Robert J. Westberg Jr.
Commander: Doug Boothe

MISSION

Delivers specialized facilities engineering and technology products and services in Shore, Ocean and Waterfront Facilities, Environment, Amphibious and Expeditionary Operations, Energy and Utilities. Provides solutions to problems through engineering, design, construction, consultation, test and evaluation, technology implementation, and management support.

CURRENT IMPORTANT PROGRAMS

- Defense Environmental Restoration Program
- Pollution Prevention Equipment Program
- Navy Shore Facilities Improvement
- Advanced Fendering Program
- Deep Ocean Technology in support of ASW
- Seabasing
- Marine Corps Amphibious Logistics
- Mobile Offshore Basing (MOBS)
- Ocean Test Ranges
- Shallow Water Test Ranges
- Ocean Moorings for Acoustic Surveillance (Std Eiger II Program)
- Marine Handling Systems for Low Frequency Active Acoustic Surveillance Systems
- Undersea Cable Burial and Survivability
- Explosives Safety
- Physical Security Systems
- DoD LOCKS Program

EQUIPMENT/FACILITIES

Deep Ocean Simulation Laboratory. Shallow Water Dive Tank. Motor Vessel Independence. Advanced Waterfront Technology Test Site. Water Purification Laboratory. Electromagnetic Pulse Test Facility. Physical Security Test Facility. High temperature pavements stand.

Deep Ocean Simulation Laboratory - This is the largest facility of its kind on the West Coast. It contains 12 pressure vessels capable of simulating the deep ocean environment under controlled conditions. It is used for certifying fleet hardware and support technology validation and testing.

Shallow Water Dive Tank - A 30-ft diameter, 65,000 gallon seawater tank for testing oceanographic equipment, diver construction techniques, diver tools and underwater non-destructive technical (NDT) equipment.

EQUIPMENT/FACILITIES

Motor Vessel Independence - A 200-ft vessel outfitted to support ocean engineering research and undersea equipment validation testing. The Independence has an A-Frame well and crane system for installation and retrieval of underwater systems.

Research Support Vessel (RSV) - A 50-foot nearshore vessel outfitted to support diving operations and oceanographic equipment testing and operations.

Remotely Operated Underwater Vehicle (ROV) - A 2000 foot capable ROV system which includes a PHANTOM vehicle, control van, handling system and experienced operating crew. May be deployed from shore or onboard surface vessels.

Advanced Waterfront Technology Test Site (AWTTS) - A half-scale 160' foot test pier with removable deck sections for testing constructability and durability (under constant stress) of waterfront construction and repair materials and systems in a corrosive marine environment. Decks can be statically loaded up to 300,000 lbs. Embedded instrumentation facilitates monitoring performance of structural components. Supports testing programs for the USA CERL, USA WES, Composites Institute and the CERF.

Linear Cable Engine (LCE) - Cable deployment system for 8000 lbs. line pull at a maximum line speed of 500 ft/min.

High Temperature Pavements Test Facility - Controlled high temperature blast facility, which simulates the jet blast of an aircraft auxiliary power unit. Used to test concrete mixtures from the effects of blasts from F-18s, B-1s and AV-8Bs.

Cable Survivability Test Flume - 100-ft by 50-ft by 3-ft deep salt water tank provides survivability testing of full-sized seafloor cabling in a flowing water environment.

Seawater Test Facility - Test site for development, test and evaluation of seawater desalination equipment and expeditionary water treatment devices for production of potable water.

Battery Laboratory - This facility supports testing and evaluation of batteries for Deep Submergence Rescue Vehicles under simulated ocean conditions in conjunction with the pressure vessels of the Deep Ocean Simulation Laboratory. Large battery chargers, load banks, cell monitoring voltage scanners and electrolyte handling equipment are used to conduct tests on silver-zinc batteries for the Navy.

Flexor Test Stand - Computer-controlled test rig capable of applying cyclical test loads of up to 300,000 lbs. for dynamic barge loading tests of Flexor Pontoon connectors.

Fiber Optics Laboratory - A 2000 sq. ft facility with temperature controlled cleanrooms for preparing glass optical fibers for precision optical measurements.

Geotechnical Modeling Test Facility - The only Navy facility for controlled testing involving dragging of implements through soils at metered rates for monitoring soil behavior. The facility is used for testing model anchors, site assessment tools, cable plows, and other implements for penetrating the seafloor.

Naval Facilities Engineering Services Center
Port Hueneme, CA 93043-4328
(805) 982-1393

Captain: Robert J. Westberg Jr.
Commander: Doug Boothe

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	0.000	0.000
6.1 Other	0.000	N/A	0.000	0.000
6.2	1.668	N/A	1.725	3.393
6.3	4.253	N/A	6.927	11.180
Subtotal (S&T)	**5.921**	N/A	**8.652**	**14.573**
6.4	10.506	N/A	10.437	20.943
6.5	0.050	N/A	0.447	0.497
6.6	0.000	N/A	0.000	0.000
6.7	1.006	N/A	0.111	1.117
Non-DOD	0.000	N/A	0.000	0.000
TOTAL RDT&E	**17.483**	N/A	**19.647**	**37.130**
Procurement	1.142	N/A	18.032	19.174
Operations & Maintenance	45.846	N/A	16.740	62.586
Other	25.539	N/A	22.798	48.337
TOTAL FUNDING	**90.010**	N/A	**77.217**	**167.227**

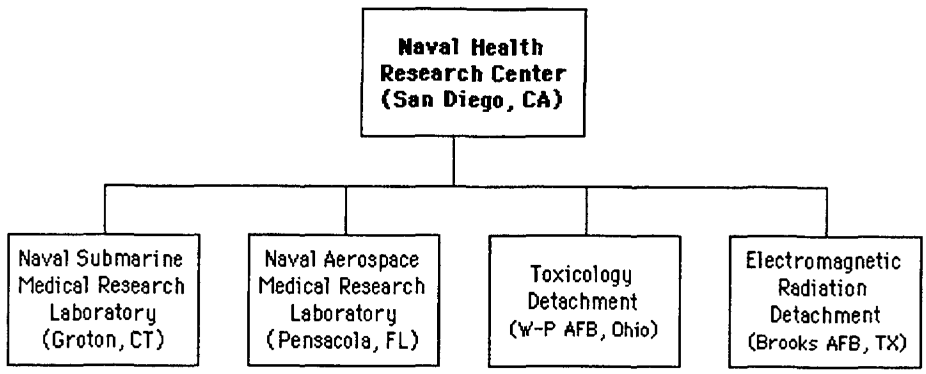
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	7	7
CIVILIAN	18	298	194	510
TOTAL	**18**	**298**	**201**	**517**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	68.000	**REAL PROPERTY**	30.000
ADMIN	84.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	35.000	**EQUIPMENT**	8.700
TOTAL	**187.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**10**	* Subset of previous category.	

Naval Health Research Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Naval Health Research Center
San Diego, CA 92186-5122
(619) 553-8400

Commanding Officer: CAPT Thomas J. Contreras, Jr.
Scientific Director: Dr. Stephen Nice

MISSION

To Naval Health Research Center conducts operational Biomedical research to enhance performance, health, safety and readiness of our military forces.

CURRENT IMPORTANT PROGRAMS

Naval Health Research Center (Laboratory)

The R&D mission at the **Naval Health Research Center (Laboratory)** addresses three programmatic areas. For updated information on all NHRC programs, please visit the Programs/Publications section of our homepage at: http://www.nhrc.navy.mil/.

Human Performance - The smaller force structure, coupled with constantly evolving mission and tactical requirements, makes it imperative that each warfighter be at peak operational readiness. This program focuses on optimizing Navy and Marine Corps operational performance through assessment of personnel performance and quantification of mission stressors that negatively influence mission success. The research includes controlled laboratory studies and studies in which researchers deploy to training locations. These research teams are widely recognized for excellence in conducting research meeting critical Fleet and Marine Corps requirements and ensuring rapid technology transfer.

Environmental Extremes - With a worldwide theater of operations, Navy and Marine Corps personnel operate in environments that can substantially degrade performance. This research quantifies the effects of exposure to environmental stressors (e.g., heat, cold, -forces) and identifies, develops, and evaluates countermeasures to performance degradation. Marine Corps and Naval Special Warfare (SEAL) cold weather operations are a core area of research.

Special Operations - Recognizing the unique requirements of Naval Special Warfare and Marine Corps Special Operations Capable personnel, this program focuses on effectively enhancing mission performance under the most arduous of operational conditions. The program is strongly user oriented, with special operations personnel involved extensively in all steps of the research process.

Protective Equipment Evaluation - Protective equipment designed to safeguard personnel in hazardous environments often places substantial physiological strain on the individual. Understanding the complex interaction of protection from the environment and the resulting impact on physiology and performance is critical to developing interventions that enhance personnel safety and operational capability.

Physical Readiness Standards - This program established the Navy's physical readiness and body fat standards. While work has continued in this area, it has expanded to encompass occupation specific, gender neutral standards that focus on enhanced operational readiness for Navy and Marine Corps personnel.

CURRENT IMPORTANT PROGRAMS

Occupational and Exercise-related Injuries - These injuries have a substantial negative impact on manpower availability, cost, and combat readiness. The research focuses on identifying prevalent risk factors for musculoskeletal injury, evaluating the efficacy of rehabilitation modalities, and injury prevention. A new area of investigation incorporates cutting-edge technologies using tissue metabolism markers to predict those at increased risk of injury, thus enhancing personnel safety and reducing the burden on the medical care system.

Medical Decision Support - Systems are developed that integrate information from multiple sources to generate indices and displays for reducing information overload and facilitating rapid responses during crises.

Occupational Health Management - Methods are developed to provide occupational safety and health managers improved capability to plan and execute environmental inspections, better identify high risk conditions, and project the cost of occupational illness and injury.

Theater Medical Information - Systems are designed to capture medical information in an operational theater, compile the information needed to support the continuity of care, project the impact on medical resources, and improve medical situational awareness.

Telemedicine - Information is gathered and analyzed to assess the impact of telecommunication technology on clinical care and medical readiness in remote operational environments.

Casualty Rate Estimation - The major objective of this work is to develop technologies that allow projections of medical attrition to be derived for the types of scenarios that Navy/Marine Corps personnel are increasingly likely to encounter. These projections include the specific illnesses and combat/non-combat injuries expected during amphibious operations, urban conflict scenarios, and a range of OOTW.

Treatment Profiles for Injuries Incurred During Military Operations in Urban Terrain - This study proposes to identify urban-specific injury profiles and develop treatment/outcome algorithms that account for the limitations encountered administering care in urban terrain. Data on medical supply utilization and patient morbidity when first responders are unable to immediately access their patient or are unable to secure medieval for prolonged periods will be developed.

Estimating Supply Program (ESP) - A computer model that uses a knowledge base comprised of detailed treatment protocols to describe the medical care sequence a casualty would receive and the supplies required to render that care was designed and developed for Navy and Marine medical treatment facilities. Currently, we are developing the database and enhancing the ESP computer program to provide the baseline medical requirements to support OMFTS and MOOTW scenarios.

Medical Readiness Modeling and Simulation - The objective of this effort is to develop a tool for medical planners to evaluate supply readiness, conduct risk assessment and course of action analysis for a variety of operational scenarios. This computer model will use casualty estimates as input to the generation of the casualty flow, the Estimating Supplies Program (ESP) and its underlying database of patient condition treatment profiles, tasks and supplies to calculate an inventory readiness index and determine operational risk for a variety of scenarios.

CURRENT IMPORTANT PROGRAMS

Operator State Modeling - Psychophysiological (e.g., electroencephalographic, eye tracking) and behavioral data are used to model states of drowsiness and cognitive overload in order to develop real-time cognitive monitoring technologies. These technologies are central to human performance optimization.

Interpersonal Violence - Data related to victimization and perpetration of aggression are collected to develop treatment, prevention, and intervention programs associated with health-care utilization. Persian Gulf War Unexplained Illness - Seven research studies of Gulf War veterans and their families have been completed and manuscripts are currently being prepared. Studies include hospitalizations, symptoms, exposures, physical performance, infertility and pregnancy outcomes.

Global Surveillance for Emerging Illnesses - As the U.S. Navy Node of the DoD Global Surveillance and Response Program for Emerging Illnesses, NHRC conducts epidemiological studies of emerging pathogens known to cause infectious illness. NHRC's active surveillance currently includes studies of the epidemiology of Streptococcus pyogenes, Streptococcus pneumoniae, Mycoplasma pneumoniae, Chlamydia pneumoniae, Bordetella pertussis, Ureaplasma urealyticum, adenovirus, influenza, and respiratory syncytial virus.

Deployment Health Research Studies - On September 30, 1999, the Assistant Secretary of Defense/Health Affairs established a DoD Center for Deployment Health Research at the Naval Health Research Center San Diego. The Center's mission includes conducting epidemiological studies to investigate the longitudinal health experience of previously deployed military personnel, and the development and evaluation of appropriate health surveillance strategies. Center research includes studies of symptoms, hospitalizations, reproductive outcomes, mortality, and other health outcomes among DoD beneficiary populations, both military and civilian. These studies involve investigations of personnel who remain on active duty and personnel who have left military service. Respiratory Disease Epidemiology - This research area focuses on the epidemiology of respiratory disease in military populations, particularly in populations of trainees with a high aggregation of susceptible individuals.

Health Promotion - Addresses the Navy's need to reduce health risks and associated healthcare costs. Current work focuses on the effectiveness of interventions for weight management, smoking cessation, and alcohol abuse rehabilitation.

Musculoskeletal Overuse Injury Prevention Research - Goals: 1) determination of the operational, fiscal, and personal impact of musculoskeletal injury in training and operational forces; 2) development of predictive profiles for injury susceptibility; and 3) development, implementation and evaluation of interventions to reduce the incidence and negative impact of these injuries.

Alcohol Misuse Prevention Research - Goals: 1) develop a cognitive-behavioral intervention program to reduce heavy drinking among junior Marine Corps personnel and promote responsible attitudes toward alcohol use, with a particular emphasis on behavior during deployments; 2) develop complementary training programs for senior enlisted and officers aimed at deglamourizing alcohol use; and 3) measure the effectiveness of intervention programs using hard outcome measures, as well as attitudes and behavioral intentions.

CURRENT IMPORTANT PROGRAMS

HIV/AIDS Prevention in African Militaries - The Naval Health Research Center has been appointed as the Department of Defense's Executive Agent for the White House established "Leadership and Investment in Fighting and Epidemic (LIFE) Program." The LIFE program is the United States program to help reduce HIV/AIDS in Africa and India and includes the US Agency for International Development, the Centers for Disease Control, and the Department of Defense. As the Executive Agent, NHRC will provide program management, scientific consultation, and oversight of the DoD Life Program in FY2001-2002. Sexually Transmitted Disease and Unplanned Pregnancy Prevention Research - Develop cognitive skills building interventions to reduce the high-risk behaviors associated with STD acquisition and unplanned pregnancy in operational military populations. This research area includes a program in HIV which is defining the epidemiology of HIV in military populations and includes molecular subtyping of HIV strains to pinpoint likely locations of acquisition of HIV infection.

Epidemiologic Research Database Development - The primary resource for hospitalization studies is the Career History Archival Medical and Personnel System (CHAMPS) Research Database, which is a computerized medical (inpatient events) and career history database that provides extensive information for Naval epidemiologic occupational health research. This longitudinal database includes information for Navy enlisted personnel dating back to 1973 and is currently being expanded to include Navy officer and Marine Corps personnel.

Long-term Psychiatric Sequelae of the POW Experience - This study is adding data to be used for prediction and prevention of negative psychiatric sequelae of captivity and torture, to allow military caregivers and policy makers to better understand the psychological impact of long-term husband and father absence, and the role of family status in the repatriation and healing process.

Evaluation and Pilot Test of the DON Suicide Incident Report - Suicide is the third leading cause of death among U.S. Sailors and Marines. This study evaluates effectiveness of DONSIR as a tool for the identification of military-specific suicide risk factors.

Navy Preventive Medicine Initiative - This project will track fitness scores, medical diagnostic codes, blood pressure, weight, and lifestyle measures (e.g., tobacco use, diet, exercise, and self-reported stress) across the course of an enlistee's military career. It will also develop, implement, and evaluate health promotion interventions using longitudinal outcome data. Survey of Navy Recruit's Behavior. This longitudinal study is determining military performance, attrition, use of healthcare services, revictimization, and recidivism are associated with interpersonal violence by evaluating self-reported history of sexual and physical assault, evaluating the consequences of abuse, identifying predictors of perpetration and victimization, and creating preventive and intervention programs.

Naval Aerospace Medical Research Laboratory (NAMRL)

Enhanced Hearing Protection for High-noise Environments: Current hearing protection devices can be inadequate in high-noise operational environments. We have developed and patented a new sound-attenuating technology that significantly improves hearing protection devices and sound attenuation in general. We are determining optimal engineering parameters for the new technology, applying them to hearing protectors and sound-attenuating materials, providing prototype models for formal test and evaluation, and developing design specifications for eventual manufacture.

CURRENT IMPORTANT PROGRAMS

Naval Aviation Pilot Prediction System: This project is: (1) centralizing existing training and mishap data for naval aviators from accession through winging and beyond; (2) determining the feasibility of using training and fleet-performance criteria to identify marginal performers; (3) developing predictive models for selection, classification, and review/mishap board analysis; and (4) developing a networked system for accessing the database and associated predictive models.

Spatial Awareness in Naval Aviation: We are developing tactile navigation and orientaion displays that enhance spatial awareness and reduce operator workload. We have developed displays that pilots and special forces personnel can use to navigate and maintain situational and spatial awareness in the absence of visual information.

Naval Aviation Selection Tools Development: We have developed an Internet version of the Aviation Selection Test Battery (ASTB) that will improve the Navy/Marine Corps aviator selection process by reducing test administration and maintenance costs, enhancing test security, and providing new opportunities to develop and validate better test items. The paper-and-pencil ASTB is taken by approximately 10,000 examinees annually at over 200 remote sites around the world. This volume of remote testing makes the ASTB an ideal candidate for implementing in a client/server format.

Landing Craft Air Cushion (LCAC) Vehicle Navigator Selection System: In the late 1980s, LCAC operators and engineers had training attrition rates as high as 40-60%. Consequently, the Naval Safety Center asked us to develop a selection system to reduce this rate. With funding from the Naval Air Systems Command, the revised LCAC selection system was delivered in 1992 and attrition rates dropped to 10-20%. Similar attrition problems among LCAC navigators led to an additional tasking to develop a selection system for this position. A task analysis was completed and a selection system was developed and validated. Preliminary screening began in May 1996. The final system is in development; a full product will be delivered in October 1998.

Attention-Directing Flight Instrument Display: All current flight instrument displays require pilots to scan instruments, one after another, and mentally integrate the data to produce flight path information. We have developed a new technique that integrates flight information in a single display, thus permitting pilots to understand their positions in flight at a glance. The new display reduces time spent on instruments to approximately 15% of that required with traditional displays and almost eliminates routine scanning.

Unmanned Aerial Vehicle (UAV) Human Factors: The objective of this project is to characterize the cognitive skills needed to pilot UAVs, and to evaluate human-factors design and interface issues in UAV control systems, panels, and displays.

Night Vision for Special Warfare: We are developing a field-worthy, operationally relevant night vision test that has known and definable relations to tests in the optometric literature and is predictive of operational performance under a variety of nighttime conditions.

Spatial Orientation Design and Training Issues: This project is aimed at improving cockpit design standards by defining relations between control compatibility, pilot spatial awareness, and pilot performance, as well as enhancing pilot performance by developing training programs that incorporate accurate models of sensory-spatial awareness.

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Approaches to Spatial Disorientation: Our task is to develop basic knowledge and models of systems involved in the control of whole-body motion relative to the earth. Current models are insufficient to predict the perceptual and sensorimotor reactions that occur in complex motion conditions. The ultimate objective is to develop mathematical models that will predict spatial orientation dynamics in complex environments of flight simulators and real flight.

Sopite Syndrome: The term Sopite Syndrome was coined to describe the extreme fatigue and drowsiness that can occur in motion and virtual environments. The project entails characterizing basic neurophysiological and behavioral effects of the syndrome, developing fleet recommendations and guidelines, and relating the syndrome to similar maladies, such as Simulator Sickness and Space Adaptation Syndrome.

Marine Corps Field Casualty Monitoring/Tracking Support: We are developing a flexible, user-friendly, information-management system for real-time correlation of tactical operation, patients, and echelons 1 through 4 evacuation and treatment resources. The system should improve medical regulating significantly on battlefields of the future.

Health Risk Appraisal of Naval Special Forces Personnel: The Department of the Navy lacks baseline epidemiological and health data needed to adequately assess and track the health status of naval Special Operations Forces (SOF) personnel. In this project, we are gathering baseline health and health-risk factor data on active duty, reserve, and retired naval SOF personnel.

Performance-Based Occupational Strength Testing for Candidate Navy Pilots/Naval Flight Officers: Goals of this project are threefold: (1) to identify selected strength-critical tasks in the Joint Primary Aircraft Trainer System (JPATS), (2) to replicate those tasks on a strength-screening device, and (3) to develop strength-enhancement programs that will enable individuals to meet or exceed the strength standards (control force requirements) specified in the JPATS MIL-SPECs.

Acoustical Composites: The acoustical composites research at NAMRL has transferred material formulas and hearing protector prototypes to two private sector manufacturers for production and sale. Three projects address the following research issues: (1) the application of the Navy's technology to large surface areas (i.e., sheets); (2) the investigation of the possible application of the technology to weight-bearing structural composites and basic research into parameters germane to the technology (in collaboration with Florida A&M/Florida State University College of Engineering); and (3) the field testing of initial sheet samples in a stateroom aboard an aircraft carrier (in collaboration with NAVSEA).

Digital Anthropometric Video-Imaging Device (DAVID): Anthropometric screening is important in military aviation due to the restrictive environments found in many of the airframes. We are developing a digital anthropometric video-imaging device (DAVID) to replace the current manual technique used to selectively screen naval aviation candidates. Electronic images will be transmitted from remote sites to a central location for processing, analysis, and storage. Stored files will be available for mishap investigations, quality control, additional measurements, other software applications, or any other reason review of a file is required.

Medical, Aptitude, and Personality Determinants of Isoperformance Curves and Their Impact on Naval Aviation Selection: Selection, attrition, and retention have always been concerns for decision-makers who must struggle with manpower issues such as pilot training requirements in naval aviation.

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The approach used here is aimed at determining whether tradeoffs exist among medical, personality, and aptitude selection variables that might be used to reduce costs and improve selection, training, and fleet performance in naval aviation. As an example of an isoperformance tradeoff, one might ask if it is possible to trade lower visual acuity scores for higher aptitude test scores in such a way that overall success probabilities in flight training remain the same. The feasibility of such an approach will be assessed by determining, in the first place, the existence of candidate characteristics that permit such tradeoffs and, secondly, by creating quantitative methods of calculating tradeoffs among multiple determinants at a given probability of passing a given training phase.

Motion Adaptation Syndrome (MAS) - Gastrointestinal Aspects: The objective of this program is to examine gastric myoelectrical correlates of the deleterious effects of motion. The significance is that if gastric myoelectrical activity correlates with nausea during provocative motion, we can readily develop methods to enhance normal, 3 cycle per minute (cpm) and prevent 4-9 cpm activity. For example, evidence indicates that eating certain foods such as carbohydrates, or taking certain motility drugs may serve to minimize motion-induced nausea by increaing 3 cpm and decreasing 4-9 cpm gastric myoelectrical activity. Laboratory work is underway in which gastric myoelectrical activity is recorded prior to exposure to a provocative motion environment specifically off vertical rotation. Maximum exposure times and motion sickness and nausea symptoms are recorded during the course of stimulation. The correlation of gastric myoelectrical activity with nausea is then examined.

<u>Naval Submarine Medical Research Laboratory (NSMRL)</u>

Submarine Escape and Rescue: This program develops and evaluates equipment and guidance designed to maximize crew survival in submarine disasters. Projects include active and passive carbon dioxide scrubbing techniques, guidance and decision aids for submarine survivors, biomedical evaluation of planned submarine escape equipment and systems, and oxygen re-breathing devices.

Low Frequency Active Sonar: Tactical use of low frequency active sonar (LFA) may result in unintentional exposure (ensonification) to recreational divers. This study assesses diver aversion and panic reaction to elements of the LFA signal to create an exposure guidance and provide input to an environmental impact statement. Current focus is on developing and executing a monitoring and mitigation program.

Submarine Atmospheres Health Assessment Program (SAHAP): The mission of SAHAP is to generate and transmit knowledge to the fleet to promote health and prevent disease and disability in submariners. Specifically, the objectives are to identify variables for a health effects database and to identify atmospheric contaminants present in all classes of operating nuclear submarines. The health and performance of submarine crews can be adversely affected by contamination with chemicals and respirable suspended particles (RSP). The goal of one project is to determine the effectiveness of contaminant control procedures by measuring concentrations of trace chemicals with novel passive diffusing monitors.

Environmental Adaptability Screening for Submarine Service (SUBSCREEN): NSMRL developed and implemented psychological and motivational screening for prospective Navy Submarine School students. Research related to this project includes reliability, validity of the screening, and outcome measures. One current project is determining the predictive capability of both SUBSCREEN and a clinical inventory to identify individuals who will later be disqualified from the submarine force for a

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personality disorder. The goal is to provide the recruiters with additional aids to evaluate prospective recruits.

Mortality of US Navy Nuclear Submariners Serving from 1969-1982: Mortality causes and rates were studied in a cohort of over 76,000 submariners who served on nuclear submarines between 1969 and 1982. In the first phase of the study, ending in the 1980s, mortality was very low compared to the general male population and the cohort was still quite young. As almost 20 years have now passed, the same cohort is being studied once again to determine if mortality rates for specific causes are affected by prior exposure to the submarine environment. Project completion is expected by April 2001.

Predicting the Detectability of Auditory Signals: This project will help the Navy estimate detection ranges for sounds emitted from submarines by modeling the human auditory capability for detecting single and complex transient signals under conditions of low and high uncertainty. An automated algorithm that uses available data to better predict the probability of detection due to combined visual and aural monitoring would highlight the self-generated noises that pose the greatest threat of counter detection. This research refines and generalizes a model of the auditory detection of transient signals of varying spectral and temporal complexity for conditions of high signal certainty.

The Naval Submarine Medical Research Laboratory (NSMRL) Watchstanding Regimen: This project will determine whether the operational performance of on-watch submariners can be improved by the use of a watchstanding schedule that takes into account current knowledge of sleep physiology. The product of this collaborative effort will be a thoroughly tested watchstanding regimen ready for implementation on U.S. Navy nuclear submarines that will improve sleep, performance, and morale at no increase in cost.

Effectiveness of Speech Recognition (NVID): This project assesses the effectiveness of speech recognition software as an efficient means of creating and managing databases via hands-free, palm-top style interfaces in noisy shipboard environments. This system could potentially save hundreds of man-hours in manual transcription and data entry. Further development of this technology may find expanded use in the maintenance of electronic medical records of Navy personnel.

Evoked Otoacoustic Emissions (EOAEs) & Inner-Ear Damage from Navy Occupational Noise Exposure: This project determines what role EOAEs should play in hearing conservation programs. The project determines whether EOAEs can be a more sensitive measure of noise-induced auditory damage than pure-tone audiograms and to what extent EOAEs can be used to predict and prevent pure-tone audiometric changes.

Spatialized Audio as a Human-System Interface: This project designs and evaluates efficient adaptive signal processing techniques for customizing spatialized auditory displays. Such displays can be used in combat and training systems. It assesses the benefits of spatialized displays for improving the detection and identification of acoustic signals (i.e., sonar and communications).

Underwater Sound Hazards for Divers: This project is focused on permissible underwater sound exposure guidance for Navy diving environments, the design and development of portable underwater sound measurements suitable for assessing noise exposure in Navy diving environments, and development of sound protective systems for divers.

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Vibration Bioeffects of Low Frequency Sound on Divers: This project investigates the bioeffects of low frequency sound on divers. The goal is to determine the vibration response of the skull, measure the vibration in body structures and measure the psychological impact and effects on diver performance.

Information Requirements in Submarine Combat Systems: Although computers can handle vast amounts of information, they may not prioritize information effectively in a particular real world situation or keep pace with changes in the situation. The information that submarine conning officers consider to be the most important for decision-making is being studied to improve the design and usability of software and displays used aboard submarines.

Spatial Thinking Ability for Submarine Personnel: Improvements in visual displays have partially relieved the cognitive demand on the submariner in maintaining a mental representation of the world outside his own ship; however, the ability for an individual to create and maintain a mental representation of the surrounding world is still vital in the submarine environment. This program attempts to identify specific mental abilities involved in faster, more accurate decisions in submarine operations.

Naval Health Research Center Detachment Brooks AFB (EMRDET)

Effects of Microwave Radiation on Cognitive Performance: The purpose of this project is to utilize a primate behavioral test battery to evaluate performance in monkeys exposed to microwave radiation. Dosimetry using a computer based monkey model is used to predict the influence of complex tissue composition on the development of hotspots during whole-body and partial-body exposure to microwaves. Dosimetry experiments validate the computer model using a homogeneous model and rhesus monkey cadaver. Experiments are planned to comprehensively investigate the whole-body and partial-body exposure effects of microwave radiation on complex monkey cognitive performance at many microwave frequencies. In doing so, issues concerning the interaction of cognitive performance tasks with radiation frequency, whole-body and partial-body specific absorption rate (SAR), pulsed microwaves, and duration of exposure will be investigated.

Chronic Exposure to Radiofrequency Induced Body Currents in the Non-Human Primate: On air capable ships, aircraft are stationed near high frequency (HF) antennas radiating in the 3-30 MHz frequency range. Recent studies have shown that HF currents are induced in flight deck personnel making contact with aircraft while loading ordnance or preparing for catapult launch. Contact with aircraft under operational conditions near HF antennas can produce a daily intermittent HF current flow in the human body as well as chronic exposure over the months of a typical aircraft carrier deployment. The primary objective of this 3-year study is to evaluate the effects of chronic exposure of the non-human primate to radio frequency fields that induce strong HF currents in the wrists and arms. Specifically, we will determine dose-response characteristics of tissue damage, grip strength, and manual dexterity during chronic HF exposure of the non-human primate to radio frequency radiation in the range of 100-200 MHz.

Millimeter Wave Absorption in the Non-human Primate Eye: The objective of this three year study is to determine contrast sensitivity functions of the monkey visual system and evaluate physical damage to the cornea and lens of the non-human primate eye exposed to millimeter wave non-ionizing radiation. This study investigates the effect of repeated exposures at power densities allowed by the current safety standards including time averaged power densities. Frequencies in the range 35 GHz to 94 GHz that are

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continuous wave (CW) and pulsed (PW) are evaluated. Psychophysical, observational and histological techniques are used to evaluate both functional and structural changes in the cornea and lens.

Radiofrequency Dosimetry of the Primate Wrist for Navy Relevant Exposure Configurations: This project is successfully providing empirical evidence to show that recently promulgated limits on RF body-to-ground and contact currents are overly conservative and unnecessarily restrictive relative to typical Navy exposure situations. As a follow-on project to our earlier study that examined RF-induced heating in the primate ankle, this project has corroborated our earlier results in showing that localized specific absorption rate (SAR) in body extremities is much less than theoretical predicitons that were based on relatively crude computer models. Those predicted SARs obtained more than ten years ago, have been used to set present DoD radio frequency exposure regulations; unfortunately, they were never empirically verified until our studies with non-human primates were started.

Assessment of Radiofrequency Energy Absorption in Navy Personnel During At-Sea Flight Operations: This project uses a simulated aircraft carrier deck irradiation system in order to produce a detailed picture of the total amount and spatial pattern of RF-induced heating in Navy personnel who are irradiated during air operations at sea. The Navy's patented RF dosimetry system is used in conjuction with our intact F/A-18A airframe and is commonly used to pinpoint RF-induced "hotspots" on the surface of full-sized human models for realistic exposure situations that exist during actual at-sea flight operations.

Prediction of Laser Bioeffects Threats on the Battlefield: This program quantifies the threat from man-portable laser system on naval aviation missions (MNS from the Naval Strike and Air Warfare Center (NSAWC) dtd 06JUL98). The program developed field data collection methodologies for multiple aviation platforms and conditions (daytime, nighttime and multiple mission profiles) for laser targeting on naval flight ranges. The methodology was used to quantify hand-held laser accuracy in acquiring aviation targets. This program generated computer models for the real-time probability of aircraft detection, illumination and bio-effects to be used for mission rehearsal and planning systems, and tactics generation.

Human Visual Performance Modeling: Moderate-to-low power lasers can permanently or temporarily disable human vision and electro-optical sensors within tactically significant ranges. Even with the use of Laser Eye Protection (LEP), the level of irradiance (i.e., glare) may exceed the capabilities of the human to operate effectively. This program provides (1) the capability to evaluate, in the laboratory, operationally relevant visual performance under laser glare conditions; and (2) a laboratory T&E center for new generation LEPs and Night Vision Goggles using aviation-related tasks (on-axis and off-axis dynamic acuity tasks, and heads-up-display (HUD) washout under glare conditions).

Laser Eye Injury Recovery Models: Our knowledge of laser eye injuries and functional visual recovery after injury is limited. New technologies (confocal Scanning Laser Opthalmoscopes) now allow us to visualize retinal tissues in much greater detail, combined with behavior-oriented visual tasks. This program develops a model for the real-time, simultaneous evaluation of retinal damage, visual functioning, and behavior in an awake non-human primate (NHP) following laser exposures of varying strength (i.e., glare, flashblindness and retinal damage). The model can be used to track the biological and behavioral recovery processes over time. This program will allow medical modeling of functional visual recovery in human's exposed to varying levels of coherent light from friend or foe.

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Naval Health Research Center Toxicology Detachment Wright-Patterson AFB (TOXDET)

Acute Lung Injury Program: The acute lung injury program is focused upon examining the pathogenesis and mechanisms of Acute Lung Injury (ALI) and its more severe from the Acute Respiratory Distress Syndrome (ARDS) related to the inhalation of toxic atmospheres that may arise in the course of Naval operations. Research is focused upon (but not limited to) examining the pulmonary response to inhaled fire environments. Pulmonary toxicity in a small animal model is examined over time using physiologic, biochemical, and histopathologic methods. Extensive physiochemical characterization and control of the exposure atmospheres permits examination of the ensuing pulmonary disease in a dosimetric manner. The objectives are to develop physiologic models of lung disease and it pathogenesis for use in predicting the risk associated with combustion atmospheres of various types. Methods developed during this effort can be used to experimentally evaluate treatment regimens for smoke-related ALI and ARDS, and as a model to develop effective prevention and control programs for various operational scenarios.

Combustion Toxicology Program: The primary objective of the combustion toxicology program is to determine the health risks that are associated with the inhalation of smoke(s) evolved by pyrolysis of materials that are either commonly deployed in Naval systems or materials that are proposed for future use. Technological advances in material science have resulted in the use or proposed use of a variety of new compounds and materials in Naval systems. Prime examples are proposed new fire suppression agents and the use of composite materials in the construction of a variety of operational systems. Potential health risks associated with the pyrolysis and combustion of these materials are unknown and represent a significant threat to effective and sustained operation. The development of models useful for predicting potential toxicity, under deployment conditions, for advisory purposes is part of the overall effort.

Degradable Chaff Countermeasures Toxicity Program: United States military aircraft and ships currently use aluminized glass chaff as a passive countermeasure for radar guided threats. Heightened concern for the health impact of deployed chaff on human and animal habitats has led to the development of an environmentally friendly, degradable chaff (EcoChaffTM), an aluminum-coated degradable vitreous oxide material. Aluminum, the principle toxic component of EcoChaffTM, has been implicated in the etiology of at least one neurodegenerative disease, although data supporting this hypothesis are inconclusive. In an effort to assist in human health and ecological risk assessment of the geographical areas over which the new chaff will be deployed, current studies are evaluating the effects of human exposure to EcoChaffTM. Environmental analysis of the Naval Research Laboratory-Chesapeake Bay Detachment (NRL-CBD), an area over which aluminized chaff has been deployed for nearly twenty years suggests that soil bioavailable aluminum levels are not significantly different from background levels. Further studies focusing on the reactivity of the aluminum coating of various chaff forms show that chaff-derived aluminum is absorbed minimally. Results from recent experiments in vivo support this finding.

Neurobehavioral Toxicology Program: This program has developed and tested three interacting toxicology assessment batteries while investigating the real-world applications of such testing. These batteries, when transitioned for fleet application, are expected to represent the most comprehensive toxicology assessment tools available. The Navy Neurobehavioral Toxicology Assessment Battery (NTAB) was designed to analyze toxicant-induced modulation of eight individuals, but interacting factors underlying human performance integrity. The Navy Neuro-Molecular Toxicology Assessment

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System (NTAS) will represent the most comprehensive available battery of in vitro and cellular level in vivo tests for prediction of, and investigation of mechanisms underlying performance-modulating toxicant exposures. The Navy Global Assessment System for Humans (GASH) is expected to represent the most comprehensive available system for field evaluation of toxicant-induced deficits in human performance capacity. The data and mathematical (PBPK/PBPD) models generated from real-world application of these batteries has been programmed by the military Deployment Toxicology initiative for utilization in the development and application, by FY2028, of field and satellite-deployed toxicant sensors systems.

Toxicity Testing Program: Although environmental regulation requires manufacturers of a substance to provide data concerning the toxic effects of their products, the Navy continues to require specialized toxicity data. This data is most often in support of Navy-unique material applications or environments and may arise from by-product formation during such uses. As a result, toxicity evaluation continues to be needed to permit safe use of required materials, especially in military unique operational scenarios.

Deployment Toxicology Program: The Military Deployment Toxicology initiative for utilization in the development and application, by FY2028, of field and satellite-deployed toxicant sensors systems is based on the development and application of newly emerging technologies whose capabilities will include the measurement of the complex chemical mixtures found in the real-world environment. However, the intelligent use of these sensors' outputs requires similar advances in the understanding of the toxicity of these mixtures and how this toxicity relates to sensor outputs. This effort is coordinating the development of methods for evaluating the toxicity of such mixtures.

Risk Assessment Program: Toxicology data provides the raw information needed to determine the hazard associated with a chemical. However, the hazard to workers involves the circumstances of their exposure. The integration of this information is the process of risk assessment that is used for reasons of both personal safety and environmental protection. Decisions affecting both personal safety and environmental impact are needed for Navy-specific chemicals and Navy-specific chemical uses ranging from operational to industrial issues. Chemical risk assessments and human health evaluations provide the basis for making these decisions.

EQUIPMENT/FACILITIES

Naval Health Research Center (Laboratory)

Occupational and Environmental Physiology Laboratory: This 8,000 square foot facility, built in 1997, provides a unique ability to address operational issues rapidly and when required, under operational conditions. The state-of-the-art equipment in the laboratory was selected to ensure high mobility and multifunction capability. Enhanced mobility allows researchers to set up temporary, yet fully operational, laboratories on-site at Fleet and Marine Corps facilities, both in CONUS and OCONUS. The laboratory's proximity to the West Coast Fleet maximizes technology transfer to the Fleet and Marine Corps operational forces. A satellite laboratory for cold-weather and altitude studies is maintained at the Marine Corps Mountain Warfare Training Center, Bridgeport, CA.

EQUIPMENT/FACILITIES

Equipment:

- **Thermal physiology:** Two environmental chambers with temperature ranges of -20° to 180° F; humidity 20-85%, each capable of holding three treadmills for exercise studies; immersion tank allowing whole-body exposure to water between 45° and 110° F.
- **Swim flume:** One of the world's largest swim flumes allows studies of immersion in static water or swimming in moving water (up to 4 knots) at temperatures between 45° and 90° F. The proximity of the flume to the environmental chambers allows research on serial wet-dry exposures such as those encountered during special operations or littoral warfare.
- **Biomechanics:** Force plates for motion and ground reaction forces, electromyography, kinesthesiology, electrogoniometry, accelerometry, 3-D motion analysis system.
- **Body composition:** Anthropometry, bone densities (dual energy x-ray absorptometry [DEXA]), bioimpedence, hydrodensitometry allow determination of body composition using the four-compartment model.
- **Ergometry:** Treadmills (2 with eccentric [downhill] capability), mechanically and electrically-braked bicycle ergometers; 7 automated and semiautomated metabolic measurement systems; incremental lifting machine; equilibrium testing; pulmonary function testing; Cybex, Kincom, and Ariel computerized muscle function testing systems.
- **Thermal imaging:** Infrared camera for dynamic measurement of weighted and gradient skin surface temperatures. Whole-body calorimetry: fluid-based tube suit for measuring heat flux from six body regions to protective ensembles or the environment.

Medical Information Systems & Operations Research Specific Equipment:

- Several Concurrent and Silicon Graphics computer systems form the backbone of the electro-encephalographic and electro-oculographic laboratory, currently used for Operator-State Assessment projects. The systems enable multi-channel real-time signal acquisition and subsequent analysis of psychophysiological and behavioral data.
- Two ASL 4000 series video-based eye tracking systems (one remote, one head mounted optics) and an electromagnetic head tracking system.

Health Sciences & Epidemiology Equipment Wet Laboratory capabilities:

- Primary focus on specimen preparation, cold storage, packaging, and some limited in-house laboratory analyses. Current laboratory analytic capabilities include: viral culture, with a current focus on identification and typing of adenovirus and influenza Argiculture and performance of antibiotic resistance testing on a variety of bacterial pathogens, including Streptococcus pyogenes and Streptococcus pneumoniae; serological and PCR assays for various pathogens are also performed.
- The laboratory is fully accredited by the College of American Pathologist.
- A second laboratory has been built and has analytic capabilities to include DNA fingerprinting of clinical respiratory isolates.

<u>**Naval Aerospace Medical Research Laboratory (NAMRL)**</u>

The **Vision Laboratory** includes a mobile night vision device (NVD) training facility ('NITE Lab') that can be used to train NVD users in the field. The 'NITE Lab' is equipped with numerous NVD demonstrations and training aids as well as optical testing and vision equipment. The laboratory has facilities for recording, digitizing, and mathematically filtering and enhancing visual images. In

EQUIPMENT/FACILITIES

cooperation with the helicopter training facility at Whiting Field (TRAWING FIVE), the laboratory is able to noninvasively record the instrument scan patterns of pilots flying the motion based, full-scale helicopter instrument trainer.

The **Spatial Disorientation Laboratory** capability is a unique national asset consisting of many one-of-a-kind research devices, as described below:

- The **Coriolis Acceleration Platform (CAP)** is the only device worldwide capable of applying combined linear and angular acceleration to the human subject. It is also the only device in the DOD inventory available to study chronic exposure to altered G environments. It uses two, independently controlled power servomechanism drive systems to generate acceleration stimuli caused by rotation about an Earth-vertical axis and/or rectilinear translation along an Earth-horizontal axis. This device has enabled scientists to make accurate simulations of many bizarre combinations of force stimuli and their effects on aerospace crewmen under carefully controlled conditions. Data gathered in various studies using the CAP continue to contribute significantly to the success of the space program and to the safety and well being of astronauts.
- The **Human Disorientation Device (HDD)** can accelerate an instrumented human subject about two head-centered axes simultaneously. It is used to help differentiate the relative roles played by the various sensory systems involved in the production of disorientation, as well as to examine the contribution of each system and subsystem to motion sickness. The HDD is also employed to study the effects of disorientation caused by rotation and tumbling. The HDD differs substantially from the Pate device in that the axes of rotation can be made to pass through the intersection of the interaural and nasooccipital lines. This permits isolating the function and stimulation of specific portions of the organs of balance in the inner ear. The device has provided direct support for many basic and applied research projects sponsored by both the Navy and NASA.
- The **Linear Angular Rotator (LAR)** is a new, short-arm (6-foot), human centrifuge capable of high rotation speeds (to 80 rpm) and precise, simultaneous, linear movement of the human along the arm. It is located in a large, cylindrical chamber upon which visual stimuli can be projected. The LAR and chamber combination will permit displaying visual stimuli at various distances from the center of rotation to about 25 feet from the subject. Due to its ability to produce accurate linear and rotational stimuli, the LAR will afford precise measurements of unilateral labyrinthine function, which should lead to improved clinical tests for detecting vestibular abnormalties. Because the device will afford linear and rotational stimuli coupled with near and distant visual stimuli, it will enable studies of visual suppression of vestibulo-ocular reflexes, and of visual information processing under conditions in which target and background stimuli vary in distance and move at different speeds.
- The **Vestibular Visual Sphere Device (VVSD)** is a new device for studying visual-vestibular interactions. The VVSD is a 12-foot sphere that can be rotated about two axes to approximately 29 RPM. A subject seated in the center of the sphere can rotate about two axes to approximately 57 RPM. Visual stimuli displayed on the interior of the sphere yield compelling, visually induced motion illusions. The VVSD permits displaying real, moving stimuli to stationary or moving subjects. Measurements of three-dimensional, visual-vestibular responses should provide gold-standard data for evaluating virtual-reality displays, and for evaluating the effects of these displays on stationary and moving observers. The device will also permit exploring conditions in which the visual suppression of vestibulo-ocular reflexes (hence the ability to track visual targets) is enhanced relative to normal. Findings from these studies should lead to techniques for optimizing information delivery through headmounted displays.

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- The **Pendular Inertial Gravitational (PIG)** devices (PIG 1A and PIG 1B) are fixed on the CAP linear track and are used to position a human subject at various angles off vertical axis while the CAP room is rotated. The PIGs can be oriented in four different directions.
- The **Equitest System** employs computerized dynamic posturography to systematically examine the effectiveness of visual, vestibular, and somatosensory inputs to balance and the timing, strength, and coordination of postural movements. This permits evaluating visual, vestibular, and somatosensory contribution to equilibrium.
- The **Pate Device** resembles a patient litter and is capable of rotating a subject about the longitudinal body axis and/or the horizontal axis through the pelvis. This apparatus has slip rings, which permit physiological monitoring, and is currently being used to study eye movements in response to rotation or perceived motion generated by moving patterns projected on a hemispheric screen in front of the subject.
- The **Ocular Counterroll Device** is used to measure ocular counterroll in response to total body tilting movement and provide information on possible changes related to aging.
- The **Off-Vertical-Rotator (OVR)** is used to gain measures of semi-circular canal and otolith function and related spatial orientation performance.
- The **Periodic Angular Rotator (PAR)** is a novel servorotator designed for studies of the dynamic response of the vestibulo-ocular system. The PAR is a high-performance motion-inducing instrument that rotates a seated subject about the Earth-vertical axis in a wide variety of stimulus waveforms.

The **Psychoacoustics Laboratory** includes acoustical test chambers, an ANSI standards compliant Real-Ear Attenuation Test Facility, a semi-reverberant test chamber for simulating various Navy operational environments, and a high-level noise test chamber. In addition, equipment is available to support analog and digital signal processing, speech analysis, spectral analysis, and radio voice communications monitoring. The psychacoustics laboratory also houses unique equipment for the design, fabrication, and testing of innovative hearing protection devices and sound-attenuating materials.

We have three **Environmental Chambers**, two of which are in adjacent rooms. One is 8 x 8 ft;the other is 10 x 16 ft. The smaller chamber, used primarily for cold exposure, has active temperature control from -5 to 25 degrees C. The larger room has active temperature control from 0 to 50 degrees C. The third environmental chamber is a free-standing room 8 x 10 ft with precise temperature (0-60 degrees C) and humidity (20-80%) control.

This command has also developed and equipped several **Mobile Field Laboratories** to study the visual, vestibular, and auditory sensory systems. These tests, by virtue of the trailers' mobility, permit our researchers to collect data at training sites, in Navy and Marine Corps operational settings, and on board ships.

Naval Submarine Medical Research Laboratory (NSMRL)

Fully equipped auditory, visual and physiological laboratories, two man-rated hyperbaric chambers, large anechoic chamber, ten computer interfaced audiometric booths, medical research library, and graphic arts capabilities.

EQUIPMENT/FACILITIES

Naval Health Research Center Detachment Brooks AFB (EMRDET)

The **Naval Health Research Center Detachment Brooks AFB** is co-located with the Army and Air Force within a Tri-service Directed Energy Bioeffects Research Complex located on Brooks Air Force Base, San Antonio, Texas. The EMRDET facilities are comprised of four structures to include Vivarium built in 1995, Lab/Technical Services building built in 1996, Ground Plane and support structure built in 1996, and Administrative/Supply building built 1997 with a total of 17,200 square feet. Of this square footage, 5,900 square feet is dedicated to Microwave and Bioengineering Lab/Support services, 4000 square feet dedicated to Laser Lab/Services, 5700 square feet is dedicated to Administrative space/storage, and 1600 square feet to Technical Service Lab.

Microwave Specific Research Assets: 10 MW pulsed microwave source @ 1.25 GHz (AN/FPS-7B radar transmitter), 4 MW pulsed microwave source @ 5.6 GHz (AN/FPS-26A radar transmitter), 4 MW pulsed microwave source @ 3.0 GHz (RT-624/SPS-30), 500 W pulsed microwave source @ 16 GHz (Hughes Transmitter # 1610H), large collection of RF/microwave field intensity/power density monitors and body-current meters, Stanford Linear Energy Doubler (>peak power of 5.62 GHz sources by 9x), Assorted 500-1000 W CW solid state RF sources/amplifiers @ 2-1000 MHz, Two metal-clad RF/MW anechoic irradiation chambers (approximately 10'H x 10'W x 20'L), simulated ship deck outdoor irradiation facility with intact F/A-18A airframe. Navy-patented RF/MW dosimetry system (Green-man & coffin calorimeters), high resolution IR camera system for surface temperature measurements, twin-well calorimetry systems for whole body SAR measurements, AAALAC accredited vivarium and Brooks AFB veterinary services. Spaces include: 4 walk-in isolation chambers for non-human primate behavioral training, Rhesus monkey behavioral models, visual & auditory thresholds, cognitive test battery-short term memory and attention, learning, time perception, motivation, color and position discrimination, induced body currents in wrist and ankle. Ocular evaluation capability: LKG 2000 electroretinography system (evaluation of visual performance), Humphrey Mastervue system (evaluation of corneal topography), konan clinical specular microscope (evaluation of corneal endothelium), Interzeig lens opacity meter (evaluation of lens opacity), Confocal scanning laser ophthalmoscope (evaluation of retinal morphology), VISTECH contrast sensitivity tester (evaluation of contrast sensitivity)

Laser Specific Research Assets: Two Coherent VERDI V-5 Diode-Pumped Lasers,Two Rodenstock confocal Scanning Laser Opthalmoscopes (cSLO) & supporting computer software, two Coherent INNOVA 70 Argon Lasers, Laboratory Controlled F/A-18 HUD, F/A-18 fuselage and cockpit, aircraft windscreens for glare studies and Laser Research Team (engineer, computer specialist, biologist, research technician, research psychologist) with over 35 years experience in laser bio-effects research.

Naval Health Research Center Toxicology Detachment Wright-Patterson AFB (TOXDET)

The **Toxicology Department** currently uses more than 20.5K square feet in three separate buildings. These facilities include WPAFB Building 433, partial areas of WPAFB Building 824, and the Animal Research Laboratory located in the Dayton Veteran's Administration Medical Complex. Together, these facilities provide cutting-edge toxicological research capabilities to support the scientific needs of the Fleet and Marine Corps. The Detachment is located aboard Wright-Patterson Air Force Base and is part of the Tri-Service Toxicology Consortium. This co-location has been critical in supporting the expansion of toxicological research capabilities for the DoD. NHRC/TD currently has more than $750K in scientific equipment which supports toxicological and neurobehavioral research programs.

Naval Health Research Center
San Diego, CA 92186-5122
(619) 553-8400

Commanding Officer: CAPT Thomas J. Contreras, Jr.
Scientific Director: Dr. Stephen Nice

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.588	N/A	0.275	0.863
6.1 Other	1.690	N/A	1.195	2.885
6.2	1.589	N/A	0.606	2.195
6.3	6.020	N/A	11.897	17.917
Subtotal (S&T)	**9.887**	N/A	**13.973**	**23.860**
6.4	2.925	N/A	11.815	14.740
6.5	0.461	N/A	2.279	2.740
6.6	0.000	N/A	0.000	0.000
6.7	0.000	N/A	0.000	0.000
Non-DOD	0.000	N/A	0.000	0.000
TOTAL RDT&E	**13.273**	N/A	**28.067**	**41.340**
Procurement	0.022	N/A	0.000	0.022
Operations & Maintenance	0.883	N/A	7.084	7.967
Other	5.065	N/A	3.178	8.243
TOTAL FUNDING	**19.243**	N/A	**38.329**	**57.572**

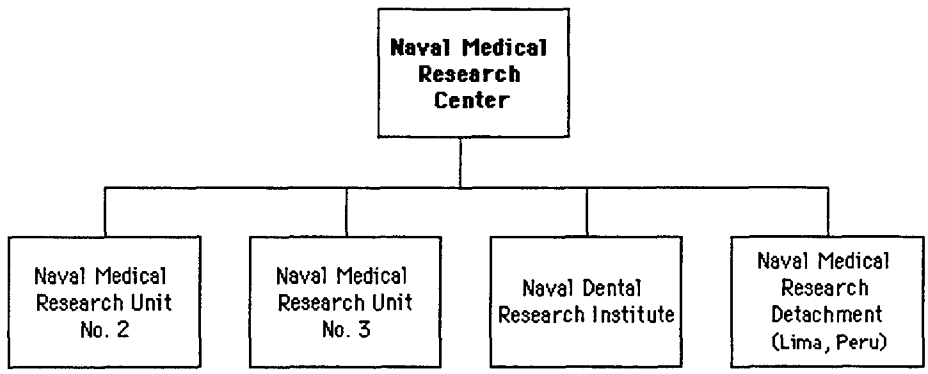
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	28	7	33	68
CIVILIAN	17	30	54	101
TOTAL	**45**	**37**	**87**	**169**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	196.567	**REAL PROPERTY**	19.635
ADMIN	48.752	* NEW CAPITAL EQUIPMENT	0.000
OTHER	13.940	**EQUIPMENT**	9.797
TOTAL	**259.259**	* NEW SCIENTIFIC & ENG. EQUIP.	0.778
ACRES	**0**	* Subset of previous category.	

Naval Medical Research Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Naval Medical Research Center
Silver Spring, MD 20910-7500
(301) 319-7400

Commanding Officer: CAPT Richard G. Hibbs, Jr
Executive Officer: CAPT Richard B. Oberst

MISSION

To conduct medical research, development, testing, evaluation, and surveillance to enhance the health, safety, performance and deployment readiness of military personnel.

CURRENT IMPORTANT PROGRAMS

BONE MARROW RESEARCH DIRECTORATE

Executive Agent for the C.W. "Bill" Young Marrow Donor Recruitment and Research Program (the Department of Defense Marrow Donor Program). The Bone Marrow Research Directorate (BMRD) provides for development of military contingency support for casualties with marrow toxic injury due to radiation or chemical warfare agents. In 1986, the Navy and the BMRD initiated federal support for the National Marrow Donor Program making unrelated donor marrow transplantation practical. The directorate:

(1) Performs laboratory research and nation-wide support for technology innovations that are transforming genetic testing for transplant matching to a highly reliable and cost effective DNA-based technology;
(2) Recruits minorities and medially supports marrow donor volunteers throughout the DoD
(3) Develops medical technologies and military medical recommendations to effectively support casualties with bone marrow failure.

COMBAT CASUALTY CARE DIRECTORATE

Immune Cell Biology Program
The Immune Cell Biology Program scientific efforts are centered upon the following three research thrust areas:

(1) Develop methods to suppress undesired immune responses, for special force medical applications (e.g., biological agent vaccine, transplantation, etc.)
(2) Develop strategies to enhance desired immune responses so as to improve defenses against a variety of infectious threats, including HIV
(3) Develop improved bone marrow transplantation methods for casualties with seriously injured bone marrow following exposure to CBR agents.

Resuscitative Medicine Research
Research in this program is focused upon the investigation of mechanisms responsible for cell death during hemorrhage to promote casualty stabilization and life sustainment following massive hemorrhage. Program efforts are centered upon four specific research areas:

(1) Development of treatment regimens such as hypothermia for the depression of metabolic rate to induce resistance to injury
(2) Examination of the role of vascular endothelium and blood elements in acute inflammatory responses and subsequent tissue injury observed hemorrhagic shock
(3) Identification of methods to modulate tissue damage triggered by hypoxia/hemorrhage
(4) Characterization of natural states of tolerance of hypoxia, such as hibernation.

CURRENT IMPORTANT PROGRAMS

Transfusion and Cryopreservation Research Program

The Transfusion and Cryopreservation Research Program centers its research efforts upon five scientific research and clinical applications:

(1) The development of automated systems for blood collection, anticoagulation, leuko-depletion, component separation and extended refrigerated storage of red cells
(2) The application of the radical discovery that cold exposure causes proteins to unfold and that they do not refold to the native configuration on rewarming. This may account for the current limitation in cold storage of blood components. Appropriate stabilizers could block this effect
(3) Apply newly developed hollow fiber separation techniques to freezing of red cells and platelets, resulting in rapid, fully automated processes
(4) Develop understanding of the fate of leukocytes in stored red cells and platelets and the clinical implications of their breakdown products
(5) Examination of the cell lesions developed during 4° C storage and their involvement in Disseminated Intravascular Coagulation and Multiple Organ Failure following massive transfusions.

ENVIRONMENTAL PHYSIOLOGY DIVISION

Oxygen Toxicity Research - The primary objective of the Oxygen Toxicity Research Program targets the etiology of neurological toxicity, resulting in convulsive seizures, by the breathing of pure oxygen under pressure. The Oxygen Toxicity Program seeks to understand the mechanism underlying this toxicity, and thereby to identify methods for prevention of oxygen-induced seizures. The program addresses the problem at various levels, from biochemical to cellular to animal models.

Thermal Stress Research - The primary objective of the Thermal Stress Research Program is to develop effective interventions, both physiological and pharmacological, and provide guidelines to minimize the impact of diving and extreme temperatures. Recommendations are provided to the operational community to improve both physical and cognitive performance in harsh environments. These recommendations may take the form of pharmacological, nutritive or training interventions.

Decompression Research - The primary objective of the Decompression Research Program is to perform basic and applied research aimed at finding new ways to accelerate decompression safely after long deep dives, as well as prevent and treat decompression sickness (DCS) in deep sea divers and crewmembers of disabled submarines. The program includes research procedures in decompression, DCS epidemiology and risk prediction, development of gas exchange kinetics and bubble dynamics models, biochemical decompression, DCS pathophysiology and pathogenesis, and control of contaminants in confined atmospheres. Direct tasking involves research for the Explosive Ordnance Disposal, Naval Special Warfare, and Fleet Submarine and Diving Communities.

BIOLOGICAL DEFENSE RESEARCH DIRECTORATE

Rapid Diagnostics and Detection Research

The mission of the Rapid Diagnostics and Detection Research Program is fourfold:

(1) To develop highly sensitive antibody-based hand-held assays which can identify BW threat agents in under fifteen minutes.
(2) To continue to improve on current assay systems and develop new ones based on intelligence threat lists.

CURRENT IMPORTANT PROGRAMS

(3) To develop biosensor-linked automated systems that will increase sensitivity and decrease assay time currently achievable in the hand-held assays.
(4) To transition rapid diagnostic assays to Operational Forces.

Confirmatory Diagnostics and Detection Research
The mission of the Confirmatory Diagnostics and Detection Research Program is to develop molecular-based techniques and assays which can confirm, validate and expand the diagnostic results of the rapid (15 min) immunological hand-held assays for the detection and identification of biological warfare agents.

Recombinant Antibody Research
The mission of the Recombinant Antibody Research Program is to apply molecular techniques to develop recombinant antibodies for the rapid detection and identification of biological warfare agents. Molecular techniques are also being used to improve specificity and/or sensitivity of existing monoclonal antibodies presently used in detection assays. Recombinant antibodies have been developed for several biological warfare agents and may be used in conjunction with currently available detection reagents. The program provides the in-house scientific research capability to produce and evaluate recombinant antibodies to augment current assays and create new assays for emerging threat agents in the most timely fashion possible.

Forward Deployable Laboratory Support
Military requirements necessitate the development of a scientific capability to deploy rapidly to an area of a suspected BW or Bioterrorism event and perform analyses leading to the identification of the suspect agent. The mission of the Forward Deployable Laboratory Support Program is to develop on a continuing scientific basis an actual deployable BW identification laboratory incorporating microbiological, immunological and molecular identification techniques.

<u>INFECTIOUS DISEASES DIRECTORATE</u>

Malaria Research
Malaria historically has posed one of the most serious threats to the health and operational readiness of deployed Armed Forces personnel. The Malaria Research Program has developed a world class laboratory regimen to meet military requirements aimed at counteracting this debilitating infectious disease threat. Two of the specific research endeavors central to the program's laboratory efforts are:
(1) The development of vaccines to prevent malaria in operating forces; and,
(2) The sequencing of the genome of Plasmodium falciparum and one other malaria parasite to facilitate malaria vaccine, drug, and diagnostics development.

Infectious Diseases Threat Assessment - The purpose of this program is to acquire systematically and assess infectious disease risk data from research projects and from collaborations with Navy CONUS and OCONUS medical treatment and research facilities for use in operational planning and research prioritization, and to develop prevention and control, diagnostic, and treatment strategies for infectious disease threats world-wide.

Enteric Diseases Research - Acute infectious diarrheal diseases are major causes of morbidity in U.S. fighting forces, posing a serious threat to the combat readiness and fighting effectiveness of deployed soldiers and sailors. To enhance the overall Force Medical Protection afforded all Armed Forces

CURRENT IMPORTANT PROGRAMS

personnel, and to maintain an excellent state of health, fitness, and job performance during operational deployments, the NMRC Enteric Diseases Research Program develops and tests new methods for the diagnosis, treatment, and prevention of infectious diarrheas. The leading bacterial causes of diarrhea in deployed U.S. forces are Campylobacter and Enterotoxigenic strains of E. Coli. To deter this threat, our mission is to:

(1) Develop a Campylobacter vaccine
(2) Improve Campylobacter diagnostics
(3) Maintain an active program of epidemiological surveillance, basic research, and vaccine development of emerging disease threats, such as newly discovered enterotoxic phenotypes of E. Coli
(4) Work jointly with U.S. Army programs to develop a combined vaccine that will protect against the most common diarrhea threats.

Viral and Rickettsial Disease Research - This program focuses primarily on three major diseases of military importance: Dengue Fever, Scrub Typhus, and Epidemic Typhus. The four Dengue viruses cause over 100 million infections annually throughout the tropical and sub-tropical zones of the world. There is currently no therapy and no vaccine. We are developing Dengue vaccines using the new DNA vaccine technology, and using molecular biology techniques to clone live, attenuated viruses. We are screening anti-viral drugs for anti-dengue activity. We are modifying existing rapid diagnostic techniques for field hospital use. Scrub and Epidemic Typhus have caused serious problems for military forces in past wars. Current efforts include adapting rapid diagnostic tests to the field hospital setting to prevent misdiagnosis, investigating reports of emerging tetracycline resistance in scrub typhus, and developing a DNA vaccine for scrub typhus.

NMRCD LIMA, PERU: This NMRC detachment operates two laboratories located at Peruvian Naval Hospital facilities in Lima and Iquitos, Peru. They conduct infectious disease research programs focused upon various viral, bacterial, or parasitic diseases known or suspected to be present in the region. The laboratory participates in the DoD Global Surveillance Program.

NAMRU-2, JAKARTA, INDONESIA: The research institute is composed of scientific research programs which include the Emerging Diseases Program, Viral Diseases Program, Parasitic Diseases Program, Bacterial and Enterics Disease Program and Administrative and Logistical Support. These scientific programs have state-of-the-art equipment to support the numerous ongoing infectious disease research projects at NAMRU-2.

The **Emerging Diseases Program** conducts field studies throughout the Indonesian archipelago and other countries in Southeast Asia such as Vietnam, Laos and Cambodia. The efforts of this program are primarily focused on surveillance for new, emerging and re-emerging infectious diseases using NAMRU-2's extensive infectious disease diagnostic and epidemiological capabilities.

The **Parasitic Diseases Program** conducts basic and applied research on malaria. Research efforts include: evaluation of new diagnostic assays, evaluation of new prophylactic and therapeutic drugs, characterization of the immune response to malaria infections to facilitate the development of potential vaccines for malaria and development and characterization of field sites for new malaria vaccine evaluations. This program utilizes sophisticated equipment such as a flow cytometer, DNA sequencer and DNA thermocyclers to conduct basic immunology and molecular biology studies of malaria. The program also has extensive entomology capabilities including the in-house breeding of mosquitoes.

CURRENT IMPORTANT PROGRAMS

The **Bacterial and Enteric Diseases Programs** conducts research to: determine the causes of acute diarrheal disease in Southeast Asia, evaluate vaccines for cholera and to support emerging disease surveillance with a comprehensive diagnostic medical microbiology capability which includes sophisticated equipment and reagents necessary for the biomolecular identification and characterization of microbial pathogens.

The **Viral Diseases Program** conducts research on the molecular biology and epidemiology of HIV and several viral diseases including dengue, hepatitis, influenza, Japanese encephalitis and Chikungunya. The program supports NAMRU-2's emerging disease surveillance efforts with extensive diagnostic capabilities for the isolation and identification of human viral pathogens. The Viral Diseases Program also includes a modular Biosafety Level 3 Containment Laboratory which when fully operational will exceed all current requirements for work with Biosafety Level 3 pathogens. This laboratory is the only one of its kind in Southeast Asia and will allow NAMRU-2 personnel and Indonesian collaborators to work safely with samples potentially containing BSL-3 agents.

NAMRU-3, CAIRO, EGYPT

Enteric Diseases Research Program

- The mission of this program is to describe the epidemiology of enteric pathogens in the region and evaluate vaccines, therapeutic agents and diagnostic assays.
- A three-year community-based, prospective cohort study in Abu Homos to examine the epidemiology of diarrhea in Egyptian children was completed in 1998. This study yielded comprehensive data on the age and pathogen-specific incidence of diarrhea, relative pathogenicity of bacterial agents, and measures of natural immunity.
- Four Phase 2 (safety and immunogenicity) trials of an oral vaccine against ETEC (enterotoxigenic E. coli) were conducted over the past three years. During the course of this study, done in partnership with the Egyptian MOHP and U.S. NIH, the infrastructure was developed to conduct large-scale intervention studies.
- An enterotoxigenic E. coli vaccine efficacy trial was initiated at Abu Homos, Egypt during October 1998.
- A new study, funded by NIH, will be the first comprehensive birth cohort study of H. pylori epidemiology in the world. This study will yield important information on the incidence and risk factor for H. pylori and other diarrheal pathogens.

Virology Research Program

- The mission of this program is to describe the epidemiology of viral pathogens, genetically and antigenically characterize virus isolates, and evaluate vaccines and diagnostic assays.
- HIV-1 genotyping is ongoing in regions where military personnel may be deployed in sub-Saharan Africa, the Middle East, and eastern Europe.
- Similarly, an influenza surveillance program has been established in three sites in Egypt and two sites in Syria. Influenza isolates are sent to WHO for evaluation and possible incorporation into the prototype influenza vaccine for the next year.
- To support the DoD HEV vaccine program, hepatitis E viruses collected from regions of the Middle East and eastern Europe are analyzed for genetic diversity.

CURRENT IMPORTANT PROGRAMS

Disease Surveillance Program

- The mission of this program is to identify, characterize and evaluate risk factors for the most important infectious disease threats in the region.
- Established a sentinel surveillance network of 6 hospitals for priority infectious diseases (meningitis, encephalitis, hepatitis, undifferentiated febrile illness, hemorrhagic fevers, influenza and dysentery), antibiotic resistant pathogens, and to establish prospective community-based surveillance for selected diseases.
- Conducted external training to facilitate the establishment of a community-based surveillance network throughout North Africa.

Disease Surveillance Program: Malaria Division

- The mission of this division is to develop and maintain a field site in a malaria endemic area to evaluate vaccines, and chemoprophylactic and therapeutic agents. This research is in support of the larger objective to reduce the risk of malaria disease to non-immune troops in the face of a world-wide resurgence of multi-drug resistant parasites and mosquito resistance to insecticides.
- A field site, located in the upper east region of northern Ghana, is being developed as a site to evaluate candidate malaria vaccines.
- In collaboration with the NMRC Malaria Program, Navrongo Health Research Center, the Noguchi Memorial Institute of Medical Research in Ghana and USAMMDA, a two-year detailed study of malaria attack rates in three cohorts was completed as well as a study of Tafenaquine for the chemoprophylaxis of P. falciparum in adults. These studies have also laid the groundwork for future vaccine trials and drug efficacy studies.

Vector Biology Program

- The mission of this program is to identify arthropod vectors, detect pathogens in vectors, evaluate control measures for vectors and assess vector-borne disease risks in the region.
- In collaboration with the Virology Program, arthropods have been collected for virus isolation studies in areas with historical outbreaks of Rift Valley Fever and West Nile Virus.
- Repellent and insecticide testing is done on vectors of local importance as a means of identifying an effective alternative to DEET and for detection of emerging insecticide resistance.
- A novel method of controlling sand flies by feeding the rodent host a "feed through insecticide" is also being evaluated. The insecticide works by interfering with a metabolic pathway present in insects, but not in mammals.

NDRI, GREAT LAKES, IL

- Continue advanced development of rapid chairside risk assessment tests for dental caries, advanced prototypes completed. Patents awarded, License pending.
- Continue advanced development of fluorescence polarization as technique for rapid diagnosis. Patent awarded. License pending.
- Develop rapid non-invasive salivary assays for presence of antibodies to tuberculosis and other infectious diseases.
- Develop tests for genetic biomarkers for periodontal disease.
- Develop protein pattern recognition technology for periodontal disease.
- Develop far-forward dental restorative material.

CURRENT IMPORTANT PROGRAMS

CHEMICAL AND BIOLOGICAL CONTAMINANTS IN DENTISTRY

- Develop systems and apparatus to remove mercury from dental waste water. Patents awarded. Industrial mercury recovery compound adapted for dental use with Nalco, Inc. Continue transition of this technology to war zone/afloat system applications.
- Develop biochemical techniques to test salivary levels of bis-phenol A associated with oral resin systems in collaboration with National Institute of Dental Research (NIDR) and ADA.

DENTAL CARE DELIVERY TECHNOLOGIES

- Develop interim dental restorative materials for use by the IDC in the war-zone that will result in dental casualty return to operational assignments within 30 minutes.
- Develop clinical protocols to minimize post-surgical complications in women.
- Continue evaluation of the Navy-wide Managed Dental Care delivery system.
- Develop miniaturized dental delivery system in support of U.S. Army Dental Research Detachment project.
- Deploy multimedia dental diagnostic and treatment system for war-zone/remote site use by IDCs. Transition software to the HTML format.

DENTAL HEALTH RELATED STUDIES

1. Investigate possible relationship between oral spirochetes and Alzheimer's Disease.
2. Develop techniques for dental materials fracture analysis/prediction with National Institute of Standards and Technology (NIST).
3. Collect and analyze dental epidemiologic data as requested by higher authority.
4. Collect and analyze operational dental emergency data.

EQUIPMENT/FACILITIES

NMRC

Naval Medical Reserach Center (NMRC) is co-located with the Walter Reed Army Institute of Research in a brand new $195M state-of-the-art facility at the Walter Reed Army Medical Center Forest Glen Annex in Silver Spring, Maryland. Officially dedicated in October 1999 after more than four years of construction, the new facility replaces scattered buildings that housed Navy researchers on the campuses of the National Naval Medical Center in what used to be the Naval Medical Research Institute and various rented locations in the Washington, DC area. The 474,000-sf facility houses more than 250 Navy and Army principal investigators. In addition to lab and office space, the new facility features a 13,000-sf library; a 58,000-sf animal facility that include isolation units and operating rooms; and seven Biosafety Level Three laboratory suites, two of which are in the animal facility.

The animal facility is connected by a tunnel and elevators to an adjoining large-animal care facility, which allows animals to be transported between buildings without breaking quarantine. The lab also contains clinical investigation suites, which lodge human volunteers for early-phase drug/vaccine research and for sleep deprivation studies.

Various areas throughout the building are designed to foster collaboration, such as a cafeteria, plaza, corner lounges and, in particular, the skylit wood-lined 90' atrium which also contains a stairway. Departmental offices ring the atrium on all three above-ground floors, so that researchers must

EQUIPMENT/FACILITIES

frequently come there to do their administrative assignments. Conference rooms are also located just off the atrium.

Although some offices in the new facility gain natural light from clerestory windows, most are small and windowless in favor of spacious labs with natural light and views of nearby Rock Creek Park. Technicians share office space beside the laboratories (with windows and sliding glass doors looking into the labs). The lab corridors have a racetrack design with the interior areas devoted to scientists' offices and support modules. The latter contain common equipment rooms, storage, decontamination rooms (one sterilizer for every ten scientists), and cold/freezer rooms. The rationale is to encourage scientists to spend more time in the laboratories and common areas where they can mingle and collaborate. The facility features a seven-foot interstitial space above all occupied areas to house wiring, pipes, HVAC, and other utilities, allowing them to be easily reconfigured. The structure's steel frame means that walls can be moved, allowing office and lab space to be reconfigured as needed.

About 75 percent of the building's professional staff are Army scientists and 25 percent are from the Navy. The facility has one fixed and two portable videoconferencing units. The auditorium, conference rooms, and teaching spaces are all connected to an electronic control center, allowing images and data to be assembled and transmitted among these and through the Internet.

Lining both exterior corridors on the main floor are a series of ten mosaics composed of ceramic tile that, up close, appear to be designs. However, when viewed from a distance, the mosaics change dramatically, presenting images of founding scientists as well depictions of the work done at the lab such as vaccine development, undersea medicine, and research into combat stress and infectious diseases. Etched in slate panels that adjoin the mosaics are quotations and citations that amplify the images.

Building Information

Total NSF: 276,000
Total GSF: 474,000 (Not included: ground floor central utility plant and mechanical rooms: 25,000; interstitial space: 474,000; mechanical penthouses: 63,000)
Building Efficiency: 58.2%
Building Population: 1,000
People Density: 474
Building Services:

- 100% single-pass-through HVAC with variable air volume controls
- Central deionized water with point-of-use final polishing
- Laboratory gases: nitrogen, compresses air, vacuum, natural gas, carbon dioxide
- Animal facility operating room: nitrous oxide, oxygen
- Direct digital building systems control
- Automated security system (cardkeys, 75 cameras)
- Computerized laboratory equipment monitoring system
- Fiber-optic cable to every communications module
- Lab/Planning Module: 30' x 30' for two principal investigators (Tissue Culture labs: 15' x 30')
- Office/Workstation Size:
  - Technicians and administrative support: 60 sf
  - Scientists: 85 sf
  - Scientific Administrators: 120 sf

EQUIPMENT/FACILITIES

- Special Equipment:
  - Electron microscopy suite (one scanning and two transmission electron microscopes)
  - Animal necropsy suite
  - Insect rearing suite
  - Peptide-labeling radiation laboratory
  - Gamma irradiator
  - Video-teleconferencing center

Overall HVAC Requirements: 4 cfm/nsf
Structure/Foundation Type: Steel frame, composite
Casework: Wood bench cabinets, epoxy countertops, painted steel shelving, and wall cabinets
Fume Hoods: 139-6'
Biosafety Cabinets:

- Class II, Type A 62-4'
- Class II, Type B 125-4'
- Class II, Type C 15-6'

NMRC-DET Lima: The NMRC Detachment, Lima, Peru is comprised of 3 buildings with approximately 33,000 square feet total. This detachment operates its main laboratory at the Peruvian Naval Hospital compound in Lima, Peru, and a field station located with the Ministry of Health in Iquitos, Peru, along the Amazon River. The detachment maintains an AAALAC accredited animal research facility.

NAMRU-2: The Naval Medical Research Unit No. 2 (NAMRU-2) is located in Jakarta, Indonesia on the compound of the National Institutes of Health (LITBANGKES), Indonesian Ministry of Health. Research laboratories, administrative offices and logistical support spaces are integrated into buildings owned by the Indonesian Ministry of Health. NAMRU-2 currently has 18.1 k sq ft of laboratories, 11.8 k sq ft of administrative offices and 33.6 k sq ft of logistical support spaces. NAMRU-2 maintains:

- AAALAC animal facility
- BL-3 Laboratory
- Electron Microscope facility with both transmission and scanning microscopes
- Scientific library
- In house maintenance facility and motorpool
- Facility electrical backup system (5 diesel generators with total of 1,170 KW)

NAMRU-2's field laboratory in Jayapura, Irian Jaya, which is 4,500 Km from Jakarta, has 4.5 k sq ft of lab space, a guest house, electrical generator backup and vehicles used for transportation to remote field sites, related laboratory assays and capabilty to process research specimens for shipment to the Jakarta lab.

NAMRU-3: Naval Medical Research Unit #3 in Cairo,Egypt maintains the following:

BIOMEDICAL RESEARCH SCIENCE BUILDING: Six-story state-of-the-art building completed in 1983. Clinical and Applied Research Laboratory. 2,750 sq ft Biosafety Level-3 Laboratory. Backup emergency generators and modern ventilation and waste disposal design.

EQUIPMENT/FACILITIES

LIBRARY: Heavily used by local scientists/physicians as well as NAMRU-3 staff. Subscriptions to over 75 scientific journals. Houses over 7,000 books.

INSECTARY: Supports colonies of disease vectors such as ticks, mosquitoes and sand flies.

ANIMAL FACILITY: Directed by U.S. Army Veterinarian and enlisted (91T) Veterinary Technician. AAALAC-International accredited state-of-the-art animal facility houses rodents, sheep, rabbits and pigeons; it has a barrier facility for breeding inbred mouse strains.

PUBLIC WORKS FACILITY: Directed by U.S. Navy Civil Engineering Corps Officer. Responsible for engineering, maintenance, construction, design, and transportation. Shops: automotive, electrical, mechanical, sheet metal, carpentry, paint and plumbing.

OTHER SUPPORT FACILITIES: Administration, Finance, Supply, Medical Equipment Repair, Safety, Occupational Health, Management Information and Post Office.

ACCESS TO ABBASSIA FEVER HOSPITAL: The largest Ministry of Health infectious disease hospital in Egypt with 1,500 beds is adjacent to NAMRU-3. NAMRU-3 conducts clinical studies in the Meningitis and Fever of Unknown Origin (FUO) wards.

FIELD SITES: The field sites for the Enteric Diseases Program are located in Abu Homos and Benha, Egypt. Virology Research Program has field sites in Syria, Egypt, Djibouti, and Czechoslovakia Republic. Malaria field studies are being conducted in Navrongo, Ghana.

NDRI: The Naval Dental Research Institute at Great Lakes Naval Station in Illinois is a 13,000 square feet AAALAC-accredited animal colony. NDRI maintains a comprehensive dental research library, numerous volumes and journals with direct online access to a variety of literature search services and has extensive computer and data processing facilities. NDRI has direct access to large military populations. Located at the Navy's only Recruit Training Center, it also has direct access to the American Dental Association, three university dental schools, two large VA hospitals, a large Naval Hospital, and a major Naval Dental Center which serves as headquarters for nearly 50 leading dental organizations. Other equipment capabilities and special features include:

- A gas chromatography microbial identification system
- Atomic Absorption Spectrometer
- Direct access to the National Institute of Dental Research, National Library of Medicine and the National Institute of Standards and Technology
- Illinois EPA Certified Waste Water Testing Facility for mercury
- Co-located with U.S. Army Dental Research Detachment
- Total facility capacity = 75,000 sq. ft.

Naval Medical Research Center
Silver Spring, MD 20910-7500
(301) 319-7400

Commanding Officer: CAPT Richard G. Hibbs, Jr
Executive Officer: CAPT Richard B. Oberst

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.533	N/A	0.000	0.533
6.1 Other	3.975	N/A	1.731	5.706
6.2	4.630	N/A	2.126	6.756
6.3	9.252	N/A	1.950	11.202
Subtotal (S&T)	**18.390**	N/A	**5.807**	**24.197**
6.4	1.748	N/A	0.000	1.748
6.5	1.047	N/A	0.000	1.047
6.6	7.395	N/A	0.000	7.395
6.7	0.000	N/A	0.000	0.000
Non-DOD	4.525	N/A	0.000	4.525
TOTAL RDT&E	**33.105**	N/A	**5.807**	**38.912**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	8.152	N/A	3.675	11.827
TOTAL FUNDING	**41.257**	N/A	**9.482**	**50.739**

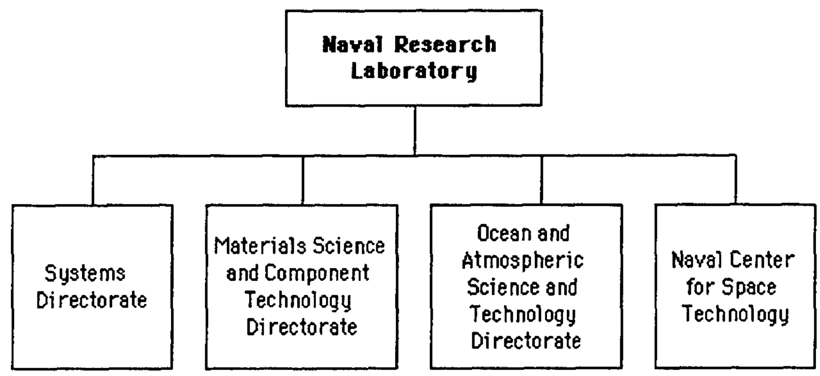
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	70	15	98	183
CIVILIAN	52	77	230	359
TOTAL	**122**	**92**	**328**	**542**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	229.500	**REAL PROPERTY**	21.770
ADMIN	71.688	* NEW CAPITAL EQUIPMENT	0.270
OTHER	79.552	**EQUIPMENT**	15.120
TOTAL	**380.740**	* NEW SCIENTIFIC & ENG. EQUIP.	1.180
ACRES	7	* Subset of previous category.	

Naval Research Laboratory

FY2000 Abbreviated Functional Chart - Technical Organizations



Naval Research Laboratory
Washington, DC 20375-5320
(202) 767-2541

Commanding Officer: CAPT Douglas H. Rau
Director of Research: Dr. Timothy P. Coffey

MISSION

Operate as the Navy's full spectrum corporate laboratory. To conduct a broadly based multidisciplinary program of scientific research and advanced technological development directed toward maritime applications of new and improved materials, techniques, equipment, systems and ocean, atmospheric, and space sciences and related technologies. In fulfillment of this mission, the Naval Research Laboratory:

(1) Initiates and conducts broad scientific research of a basic and long-range nature in scientific areas of interest to the Navy.
(2) Conducts exploratory and advanced technological development deriving from or appropriate to the scientific program areas.
(3) Within areas of technological expertise, develops prototype systems applicable to specific projects.
(4) Assumes responsibility as the Navy's principal R&D activity in areas of unique professional competence upon designation from appropriate Navy or DoD authority.
(5) Performs scientific research and development for other Navy activities and, where specifically qualified, for other agencies of the Department of Defense and, in defense-related efforts, for other Government agencies.
(6) Serves as the lead Navy activity for space technology and space systems development and support.
(7) Serves as the lead Navy activity for mapping, charting, and geodesy (MC&G) research and development for the National Imagery and Mapping Agency.

LEADERSHIP AREAS: NRL, the Navy's single, integrated corporate laboratory, provides the Navy with a broad foundation of in-house expertise from scientific through advanced development activity. Specific leadership responsibilities and expertise are maintained in the following areas:

(1) Primary in-house research for the physical, engineering, space, and environmental sciences
(2) Broadly based exploratory and advanced development program in response to identified and anticipated Navy needs
(3) Broad multidisciplinary support to the Naval Warfare Centers
(4) Space and space systems technology, development, and support.

CURRENT IMPORTANT PROGRAMS

Advanced Multifunction Radar Frequency Concept (AMRFC); Solutions for applications to COMSEC devices, network security tech, key management; TARPS-CD/SHARP Program; Damage control/automation for reduced manning; GaN-based power devices for Advanced Multifunctional RF System; Compact Radiation and Acceleration Sources for EW and IR Countermeasure; Integrated C4I for Marine Corps; Virtual Hub for Multi-INT Data; Passive Microwave Ocean Wind Satellite (WINDSAT); Physics of Coastal Remote Sensing; Dynamic Ocean Linkages in the Asian Marginal Seas; Alteration of Sediment Properties through Dissociation of Gas Hydrates.

CURRENT IMPORTANT PROGRAMS

CRADAs ACTIVE DURING FY00

NRL-95-078 Title: Electronic Support Systems Technology CRADA Between NRL and AIL Systems, Inc.

NRL-95-079 Title: Quantitative Mobility Spectrum Analysis for Hall Evaluation Software Package CRADA Between NRL and Lake Shore Cryotronics, Inc.

NRL-96-108 Title: Magnicon Development at 11.4 GHz CRADA Between NRL and Omega-P, Inc. (OPI)

NRL-96-119 Title: Radiation Hardness In Thin Simox CRADA Between NRL and Ibis Technology Corporation (ITC)

NRL-96-122 Title: Proof-of-Principle Experiment of the Vacuum Beat Wave Accelerator CRADA Between NRL and Omega-P, Inc. (OPI)

NRL-97-132 Title: Ion Implantation Technology for GaN and Related Alloys CRADA Between NRL and Implant Sciences Corporation (ISC)

NRL-97-135 Title: Digital Library Research CRADA Between NRL and Visual History Foundation (VHF)

NRL-97-142 Title: Diamond Based Materials Research CRADA Between NRL and Diamond Microelectronics Corporation (DMC)

NRL-97-155 Title: Development of Bi-Stable, High Resolution Reflective Display as a Memory Device CRADA Between NRL and Opticom ASA (O-ASA)

NRL-97-159 Title: Fiber Optic Seismic Systems CRADA Between NRL and Optical Producrs, Inc.

NRL-97-160 Title: Conversational Case-Based Reasoning Research CRADA Between NRL and Inference Corporation (IC)

NRL-97-162 Title: Advanced Radar Modeling and Simulation Tool for Electronic Warfare Research CRADA Between NRL and Photon Research Associates (PRA)

NRL-97-163 Title: X-Ray Absorption Analysis and Experiments CRADA Between NRL and PPG Industries, Inc. (PPG)

NRL-97-166 Title: Anti-Ship Cruise Missile (ASCM) Tactical Analysis Workstation Development CRADA Between NRL and Sippican, Inc., Hycor Division (HYCOR)

NRL-98-169 Title: On-Line Fiber Bragg Grating Implementation CRADA Between NRL and Spectran Specialty Optics Company

CURRENT IMPORTANT PROGRAMS

NRL-98-173 Title: Commercial Development of Halloysite Controlled Release System CRADA Between NRL and New Zealand China Clays, Ltd.

NRL-98-177 Title: High Data Rate SATCOM Networks for Disadvantaged Users CRADA Between NRL and Orion Network Services, Inc.

NRL-98-181 Title: Meteorological Satellite Application System (METSAS) CRADA Between NRL and SeaSpace Corporation

NRL-98-188 Title: Germanium Strip Detector System for X-Ray and Gamma-Ray Spectrometry and Imaging

NRL-98-189 Title: Virtual Enterprise Endeavor CRADA Between NRL and Husky Labs

NRL-98-190 Title: Improved Electronic Access to Journals Published by the American Institute of Physics CRADA Between NRL and American Institute of Physics (AIP)

NRL-98-192 Title: Multi-Channel Integrated Optic Phase Modulators CRADA Between NRL and Dylor Corporation (DC)

NRL-98-197 Title: Development of Commercial Towed-Array System Including a Man Portable Multisensor Towed Array System (MTADS) Adjunct for Survey of Hazardous Metallic Material CRADA Between NRL and Blackhawk-Geometrics, Inc. (B-G)

NRL-98-201 Title: Boundary Element and Finite Element Models for the Application of Nearfield Acoustic Holography CRADA Between NRL and Automated Analysis Corporation (AAC)

NRL-98-204 Title: Development of Metal-Insulator-Metal Ensemble (MIME) Materials for Chemical Sensing CRADA Between NRL and Microsensor Systems, Inc. (MSI)

NRL-98-211 Title: Structural Acoustics of Aircraft Interiors CRADA Between NRL and Cessna Aircraft Company (CAC)

NRL-98-214 Title: Measurement and Analysis of the Radiation Response of InGaP/InGaAs Solar Cells in Terms of Displacement Damage Dose CRADA Between NRL and Essential Research, Inc. (ERI)

NRL-98-221 Title: Commercial Radiation-Tolerant Deep Submicron CMOS Microelectronics CRADA Between NRL and Mission Research Corporation (MRC)

NRL-98-224 Title: Polymer Selection and Deposition Techniques for Resistive and Capacitive Mode Chemical Sensor Arrays CRADA Between NRL and Cyrano Sciences, Inc. (CSI)

NRL-98-226 Title: Field Emitter Array Development for Power Grid Switching Applications CRADA Between NRL and Diamond Microelectronics Corporation (DMC)

NRL-98-228 Title: Advanced Receiver and Signal Processing Research CRADA Between NRL and Lockheed Martin Corporation-Ocean, Radar and Sensor Systems (LMC)

CURRENT IMPORTANT PROGRAMS

NRL-99-231 Title: Inorganic-Organic Hybrid Polymers for Aircraft Engine Applications CRADA Between NRL and United Technologies Corporation (UTC)

NRL-99-234 Title: Advanced Shipboard IR Decoy Development CRADA Between NRL and Sippican, Inc. (SI)

NRL-99-235 Title: Project Starshine CRADA Between NRL and Utah State University (USU)

NRL-99-236 Title: Foreign Asset Exploitation Support CRADA Between NRL and Jaycor

NRL-99-239 Title: DAMA/HF Waveform Development CRADA Between NRL and Rockwell Collins Government Systems (RCGS)

NRL-99-241 Title: Blossom Point Dual Use Technology Study CRADA Between NRL and AlliedSignal Technical Services Corporation (ATSC)

NRL-99-242 Title: Advancing the Development of a YSI Microfluidic Sensor Platform CRADA Between NRL and YSI, Inc. (YSI)

NRL-99-243 Title: Vertical and Near-Vertical Alignment of Liquid Crystals CRADA Between NRL and Spatialight, Inc. (SI)

NRL-99-244 Title: Nuclear Magnetic Resonance of Deep-Sea Gas Hydrate Formation CRADA Between NRL and Monterey Bay Aquarium Research Institute (MBARI) and Schlumberger Technology Corporation (STC)

NRL-99-246 Title: Tripod Operators for Determining the Pose of Industrial Parts in Six Degrees of Freedom (6-DOF) CRADA Between NRL and Perceptron, Inc., The Ford Motor Company, Microdexterity Systems, Inc., and The National Center for Manufacturing Sciences, Inc. (PFMN)

NRL-99-249 Title: Fiber-Optic Oil Well Sensors CRADA Between NRL and Halliburton Energy Services, Inc. (HES)

NRL-99-251 Title: Digital Emergency Medical Service Satellite Networking CRADA Between NRL and The University of Texas Health Science Center at Houston (UTH)

NRL-99-253 Title: Displacement Damage Dose Analysis of the Radiation Response of Multi-Junction Space Solar Cells CRADA Between NRL and Lockheed Martin Missiles and Space (LMMS)

NRL-99-255 Title: Ka-band Phased Array Antenna CRADA Between NRL and Paratek Microwave, Inc. (PMI)

NRL-99-256 Title: Tool for Computer-Controlled Automation of the MAPLE Direct-Write Method CRADA Between NRL and Potomac Photonics, Inc. (PPI)

CURRENT IMPORTANT PROGRAMS

NRL-00-258 Title: Ultrasonic Non-Destructive Evaluation of Above-Ground Storage Tanks CRADA Between NRL and Solex Robotics Systems (SRS)

NRL-00-259 Title: Development of Coatings for Corrosion Control CRADA Between NRL and Niles Chemical Paint, Inc. (NCP)

NRL-00-262 Title: Effects of Electrode Conditioning on High Power Discharges in Flash X-Ray Diodes CRADA Between NRL and Ecopulse, Inc. (EPI)

NRL-00-264 Title: Microbial Production of Heavy Metal Biosorbents CRADA Between NRL and MBI International (MBI)

NRL-00-265 Title: Signal Processing for Fiber Optic Medical Sensors CRADA Between NRL and Advanced Sensor Technology (AST)

NRL-00-268 Title: Investigation of Increased Spontaneous Fission Rate of 235-U Under Acoustic Compression CRADA Between NRL and JWK International Corporation (JWK)

NRL-00-269 Title: Pulsed Laser Deposition of Ferroelectric Thin Films for Tunable Microwave Devices CRADA Between NRL and Paratek Microwave, Inc. (PMI)

NRL-00-270 Title: SiGe Interband Tunneling Diodes CRADA Between NRL and University of Delaware (UD)

NRL-00-271 Title: Development of Metal-free Anti-fouling Coatings Using a Non-persistent Biocide CRADA Between NRL and Sigma Coatings BV (SCBV)

NRL-00-272 Title: Apparatus and Procedure for Testing Fiber Optic Accelerometers CRADA Between NRL and Litton Systems, Inc., Guidance & Control Systems Division (LGCS)

NRL-00-273 Title: Fiber Optic Sensors for Oil Exploration CRADA Between NRL and Schlumberger Technology Corporation (STC)

NRL-00-274 Title: Data Collection and Transmission for Tank and Void Corrosion Monitoring System CRADA Between NRL and Veriteq, Inc. (VI)

NRL-00-276 Title: Development of Drug Compliance Chemical Detector CRADA Between NRL and Nanosphere, Inc. (NI)

NRL-00-282 Title: A Neural Network Ensemble Approach for Unexploded Ordnance (UXO) Classification in Magnetometry Surveys CRADA Between NRL and Rocky Mountain Adaptive Software, LLC (RMAS)

NRL-SSC-95-006 Title: Marine Geophysical Systems CRADA Between NRL and C&C Technologies, Inc. (C&C)

CURRENT IMPORTANT PROGRAMS

NRL-SSC-96-001 Title: LOCUTUS Software Support CRADA Between NRL and Fred Griswold Engineering, Inc. (FGEI)

NRL-SSC-96-002 Title: Deep-Towed Acoustic/Geophysical System CRADA Between NRL and Seafloor Surveys International, Inc.

EQUIPMENT/FACILITIES

Radar signature: A unique capability to calculate, analyze, and visualize spatially extended radar signatures of very low observable ships and antennas in a sea multi-path environment. Silicon graphics origin 2400 with 24 processors & 24 GB & UNIX and INTEL computers.

High Assurance Technology Development Laboratory to design, develop and test communications technology, electronic key management systems, secure voice technology and other high assurance products.

Fiber optic acoustic sensor arrays for towed, hull mounted and bottom mounted systems: Affordable array technology (AAT), lightweight wide aperture array (LWWAA) and all optical deployable array (AODS).

Structural Material Test Facility: An instrumented facility (Gleeble 3200) for simulating structural material performance at widely varying heating and cooling rates, applied compressive and tensile stresses imposed by different strokes or forces at various environmental conditions.

EPI Center: A completely instrumented EPI Center for designing novel epitaxially grown hetrostructures using molecular beam epitaxy. New capability includes designing of ferromagnetic semiconductors such as Group III-Mn-Group V to optimize non-volatile character with band gap engineering.

Pulse Laser Deposition Facility: Features 1.2J/pulse-eximer laser and magnetron gun for use on multiple targets at variable substrate temperatures for controlled deposition of metallic, organic, ceramic and bio-derived materials.

Acoustic Pool Facilities: Three tanks filled with deionized water or sea-water, with in-water robotic scanners generating nearfield acoustic holography and 3-D laser vibrometry, radiation, and scattering databases for studying submarine and mine structural acoustics and ocean bubble phenomena and acoustic interactions.

Tactical Atmospheric Modeling System/Real Time(TAMS/RT): Deployable atmospheric prediction system which consists of 3 computers and software: (1) SGI Origin 2000 computational server, which runs the COAMPS prediction system; (2) HP 0200 database server, which runs the NRL Tactical Environmental Data Server(TEDS); and (3) SGI 02 graphic console, which runs the graphical user interface, web server, and visualization software.

EQUIPMENT/FACILITIES

Large Angle Spectrometric Coronagraph (LASCO) and Extreme Ultraviolet Imaging Telescope (EIT): Located in solar orbit at a position between the Earth and Sun, on the Solar and Hemispheric Observatory (SOHO) spacecraft, providing continuous monitoring of the Sun to provide an early warning of pending disruptive solar phenomena.

Spacecraft Robotics Engineering and Controls Lab

Precision Clock Evaluation Facility

MIDWAY Research Center Precision Spacecraft Calibration Facility

Naval Research Laboratory
Washington, DC 20375-5320
(202) 767-2541

Commanding Officer: CAPT Douglas H. Rau
Director of Research: Dr. Timothy P. Coffey

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.000	N/A	0.000	0.000
6.1 Other	87.034	N/A	9.264	96.298
6.2	87.728	N/A	49.525	137.253
6.3	73.565	N/A	100.225	173.790
Subtotal (S&T)	**248.327**	N/A	**159.014**	**407.341**
6.4	17.258	N/A	28.531	45.789
6.5	9.459	N/A	17.429	26.888
6.6	8.432	N/A	8.547	16.979
6.7	16.358	N/A	48.720	65.078
Non-DOD	37.260	N/A	32.222	69.482
TOTAL RDT&E	**337.094**	N/A	**294.463**	**631.557**
Procurement	21.683	N/A	41.309	62.992
Operations & Maintenance	13.706	N/A	28.809	42.515
Other	12.058	N/A	13.210	25.268
TOTAL FUNDING	**384.541**	N/A	**377.791**	**762.332**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.067

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	SCIENTISTS & ENGINEERS: DOCTORATES	SCIENTISTS & ENGINEERS: OTHER	TECHNICAL SUPPORT & OTHER PERSONNEL	END STRENGTH
MILITARY	5	0	168	173
CIVILIAN	802	792	1126	2720
TOTAL	**807**	**792**	**1294**	**2893**

SPACE AND PROPERTY

BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	3201.107	**REAL PROPERTY**	194.466
ADMIN	196.714	* NEW CAPITAL EQUIPMENT	0.286
OTHER	323.615	**EQUIPMENT**	485.497
TOTAL	**3721.436**	* NEW SCIENTIFIC & ENG. EQUIP.	13.925
ACRES	**533**	* Subset of previous category.	

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Naval Surface Warfare Center

FY2000 Abbreviated Functional Chart - Technical Organizations

Naval Surface Warfare Center

Carderock Division

Ship and Ship Systems (Includes Submarine HM&E)
- Total Ship Systems
- Business Directorate
- Hydromechanics
- Machinery
- Structures, Survivability & Materials
- Macinery Research & Development
- Machinery In-Service Engineering

Dahlgren Division

Surface Ship Combat Systems
- Surveillance. Detection, Control and Engagement
- Electronic Warfare
- Theater Air Defense

Littoral Warfare Systems
- Mine Countermeasures
- Amphibious and Special Warfare
- Diving

Navy Strategic Weapons Systems

Pt. Hueneme Division*

Surface Ship Combat Systems
- *Combat Direction Systems*
- *Operational Programs Software Support*
- *Surface Ship Combat and Weapons Systems ILS*
- *Systems Technology*
- *In-Service Engineering of Combat Systems*

Ship Systems
- *Underway Replenishment*

Indian Head Division

Ordnance
- Energetic Systems
- Energetics, Manufacturing Technology & Material Development
- Underwater Warhead RDT&E
- Tri-Service CAD/PAD Technology Support
- Explosive Safety Standards
- Ordnance Environmental Protection
- Missile In-Service Energetics Engineering
- Package Handling Storage and Transportation (PHST)
- Energetic Quality Evaluation

Naval Warfare Assessment Station, Corona*

- *Performence Assessment*
- *Quality and Readiness Assessment*
- *Tactical Training Range Engineering Management*
- *Measurement and Test Assessment*

Crane Division*

Surface Ship Combat Systems
- *Microwave Component Technology*
- *Microelectronic Technology*
- *Electrochemical Power Systems Engineering*
- *Gun Weapons Systems Technology*
- *Radar Engineering & Industrial Support*
- *Electronic Warfare Systems Technology*
- *Ammunition Management*
- *Physical Security Ashore & Afloat*

**As a result of applying the In-House RDT&E Activity criteria at the division or major site level (see NOTE on page 3-1), NSWC Port Hueneme Division, Crane Division, and NWAS Corona data is not included in the FY2000 report.*

Naval Surface Warfare Center
Arlington, VA 22242-5160
(703) 602-0632

Commander: RADM M.G. Mathis
Technical Director: Dr. Daniel M. Viccione.

MISSION

Operate the Navy's full spectrum RDT&E, engineering and fleet support center for ship hull, mechanical and electrical systems, surface ship combat systems, coastal warfare systems, and other offensive and defensive systems associated with surface warfare.

CURRENT IMPORTANT PROGRAMS

<u>**Carderock Division**</u>

Major Acquisition Programs
All major ship acquisition programs including SEAWOLF and VIRGINIA Class Submarines; DD-21 Surface Combatants; CVN-77 and CVNX Aircraft Carriers; LPD-17 and LHD-8 Class Amphibious Ships; and combatant craft and unmanned vehicles and all in-service ships, submarines and combatant craft (including U.S. Army and Marine Corps watercraft) are supported by Ship and Ship Systems Core Equities for Signature & Silencing Systems, Vulnerability & Survivability Systems, Machinery Systems & Components, Hull Forms & Propulsors, Structures & Materials, Environmental Quality Systems, and Ship Design & Integration Technologies. In addition, support is provided for logistics systems for inter- and intra-ship materials handling, for logistics over-the-shore, and for CALS related to major ship and weapon systems acquisition programs.

VIRGINIA Class Submarine
Provide design support and technology assessment for the new attack submarine program. Includes all hull, mechanical & electrical (HM&E) technology areas, platform related combat & weapon subsystems, as well as cost and military effectiveness analysis. Work categories include: auxiliary systems, Atmosphere Life Support systems, CAD/CAM, cost effectiveness, electrical systems, EM silencing, fairwater, hydrodynamics, propulsor development, ship control, stealth-target strength, stealth-machinery, stealth-self/radiated noise, structures/materials, survivability, management systems and program support.

SEAWOLF Class Submarine
Participate in the design, construction, testing and operation of the SSN-21 SEAWOLF Submarine Class. Participate in the development and assessment of technologies and designs for alternative mission variants of the SEAWOLF Class.

DD-21 Surface Combatant
Provide technical support to the DD-21 acquisition office in the areas of ship design and systems engineering, weights and arrangements, signatures, hydrodynamics, structures & materials, vulnerability, propulsion and machinery, manning, automation, habitability, environmental engineering, producibility, auxiliary systems, affordability, modeling and simulation, logistics, life cycle management, in-service engineering, and HM&E software certification. In addition, under acquisition reform, the Carderock Division is providing support in the form of facilities utilization, testing, science and technology expertise, and other areas as tasked by Industry teams while assuring the integrity of the acquisition process by protecting competition sensitive information.

CURRENT IMPORTANT PROGRAMS

New Aircraft Carriers
Provide design support and technology assessment for the future carriers program, including CVN77 and CVNX. Includes all hull, mechanical & electrical (HM&E) technology areas, survivability analysis and design, signatures analysis, and cost analysis. Work categories include: auxiliary systems, CAD/CAM, cost effectiveness, electrical systems, propeller design, ship control, structures/materials, survivability, management systems and program support.

LPD-17
Provide design support and technology assessment for the LPD 17 program. Includes all hull, mechanical & electrical (HM&E) technology areas, survivability analysis and design, test and evaluation, and cost analysis. Work categories include: auxiliary systems, CAD/CAM, cost effectiveness, electrical systems, propeller design and testing, ship control, structures/materials, survivability, trials planning and support, management systems, and program support.

LHD-8
Provide advanced planning and program support.

In-Service Ships
Provide routine and emergent repair planning and technical management. Support FMP initiatives. Provide design support and technology assessment, including all hull, mechanical & electrical (HM&E) technology areas, survivability & signatures analysis and design, and test & evaluation. Conduct R&D as directed by program sponsors. Provide trials planning and support. Provide direct management and technical personnel support to programs.

Combatant Craft
Provide research and development, concept feasibility, design, test and evaluation, integrated logistics support, technical manuals, provisioning, construction engineering support, in-service engineering, planning yard (Army and Navy), life cycle manager (life rafts), inventory manager, direct fleet support, special project support and total craft systems engineering and integration, U.S. Navy craft design and engineering authority. This work is carried out for the Army, Marine Corps and Special Operations also.

Marine Corps Programs
Program Manager and Technical Development Agent for USMC Maneuver, Survivability, Mine Countermeasures, Transportation/Maintenance, Corrosion Control and Advanced Technology Demonstration (ATD) science and technology (S&T) programs; manage technology transfer between USMC and other services. Supporting the following major programs: Advanced Amphibious Assault Vehicle (AAAV) ACAT-1D, Assault Amphibious Vehicle (AAV7A1) family, Logistics Vehicle System Replacement (LVS-R), Light Armored Vehicle (LAV) Family, Interim Fast Attack Vehicle (IFAV), Family of Internally Transportable Tactical Vehicles (IT-LTV), Light Tactical Vehicle Replacement (LTVR), Small unit Riverine Craft (SURC). We provide the following products and services: Independent design analyses for land mobility, water mobility and survivability components and systems; test and evaluation of expeditionary systems, and program management support. Our customers include various USMC PMs (DRPM-Advanced Amphibious Assault Vehicle, PM-Assault Amphibious Vehicle, Director-Ground Weapons, Director-Combat Support and Logistics Equipment, PM-Light Armored Vehicle), Office of Naval Research (Div 353), and DARPA.

CURRENT IMPORTANT PROGRAMS

Logistics Programs

Major Programs Supported: Joint Service logistics programs such as JCALS, IETMs, and JLOTS; Navy and Army logistics programs dealing with ships, ship systems, vehicles, and watercraft; LPD-17, AAAV, DD-21, NSSN; CVX. Major Products Provided: Logistics RDT&E studies, concepts, designs, hardware, testing, and ISE engineering support and documentation. Automated Maintenance Environment for F/A-18; Joint Interoperability Architecture for IETMs. Customers Supported: NAVSEA, NAVAIR, NAVSUP, NAVFAC, PEOs, Type Commanders, SURFLANT, SURFPAC, etc; other governmental agencies, OSD, Air Force, Army, EPA, Department of Transportation, DARPA; and private industry.

Environmental Quality Pollution Abatement
Provide continued in-service engineering (ISE) support to NAVSEA and fleet customers in order to effectively maintain, operate and support this equipment to provide the fleet with maximum operational capabilities while operating in restricted waters. The pollution abatement systems include sanitary waste collection and treatment, oily waste management and processing, solid waste management, incineration, compaction, shredding, pulping and hazardous materials/waste management and control.

Electric Drive System
Develop affordable electric propulsion and auxiliary equipment, which maintains or improves platform capabilities and reduces acoustic noise from electrical equipment.

Acoustic Submarine Trials
Provide subsurface acoustical data on the Navy's fleet and private companies.

Electric Power Distribution System
To develop advanced electrical distribution system concepts meeting mission requirements at reduced costs.

Composite Structures
Develop and demonstrate advanced composites for application to surface ship and submarine structural systems/components and related non-marine dual-use applications.

Computational Mechanics
To perform research, development, and advanced application of computational methods and tools in the fields of structural mechanics, fluid dynamics, acoustics, and electromagnetics for solving engineering problems related to vehicle signatures, performance, and affordability. Also included are the enabling technologies of geometric and numerical modeling, optimization, visualization, and massively parallel processing.

Surface Vehicle Electromagnetic Signal Silencing
To develop and demonstrate technology in order to reduce surface ship underwater Electromagnetic (EM) Signature (0-1 khz) and reduce vulnerability to magnetic mine threat for MCM and steel hull surface ships.

CURRENT IMPORTANT PROGRAMS

ACTIVE COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (FY00)

Passive Fire Protection. The objective of this Agreement is to investigate potentially superior fire protection systems for use on Naval vessels and other craft through the use of materials which have demonstrated superior performance in non-marine fire protection applications.

Pipe Fitting Fabrication Process. The objective of this Agreement is to conduct a review of the pipe fitting fabrication process and identify recommendations for coating/lubrication of fittings for bending operations.

Shock Mitigation Seat. The objectives of this CRADA are:

1. To directly compare the prototype shock mitigation seat developed by Purple and Green Research Inc. with a STIDD seat. The STIDD seat is a shock mitigation seat currently being used onboard the MK-V. The prototype seat will be installed onboard a MK-V so comparative testing can be conducted.
2. To analyze acceleration data collected from testing and determine the level of acceleration dampening that occurred on the Purple and Green Research Inc. seat as well as the STIDD seat. This data will be used to directly compare the two seats against each other and determine which seat performs best in the tested environment.
3. To further develop the Purple and Green Research Inc. seat by utilizing the collected and analyzed test data. Make any necessary design changes to the seat and pass the technology onto other applicable craft.

Paint Coatings Blistering Evaluation. The objective of this agreement is to conduct a review of the paint coatings applied on the trash compactor units and identify recommendations for coatings in high humidity and salt-laden environments.

Double Hull and Composite Material/Structure Technologies. Ingalls and CDNSWC will perform a cooperative research and development effort to develop composite material/structures and double hull structures and associated sub-elements and technology for surface ships. It is anticipated that the work conducted will result in designs that can be realized in advanced surface combatants, retrofit activities to same, and commercial applications alike. The goals for these new designs will be tailored for each application and will include, as appropriate, reduced weight, enhanced survivability, reduced maintenance, and comparable cost, or lower. Ingalls, upon successful completion of development, intends to carry out a plan for marketing the technologies for a variety of naval and commercial applications.

Shipboard Power Systems Improvement Program. To evaluate specific applications of WI&CSD developed power and control system designs and concepts to Navy and commercial ships. Successfully proven applications may later be shared with other Westinghouse departments to improve commercial product lines.

Study of Reduced Fire Hazard Silicone Materials For Navy Applications. To develop, document and evaluate silicone-based or silicone modified advanced fire resistant materials. Also, reformulate and optimize processing characteristics of the above polymeric materials to conform to Navy selected fabrication techniques. Facilitate successful fire resistant materials for use in commercial applications.

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Organize technical workshops involving Navy and Dow Corning personnel to further understand the needs and capabilities of the partners.

Modular Utility Core. The objective of this partnership is to jointly develop a modular utility core for low/moderate income housing. This core will be a prototype modular unit containing the mechanical, electrical and energy management systems for residential housing. The prototype modular utility core is intended to be fabricated at Naval Surface Warfare Center, Carderock Division Philadelphia, PA, transported to a residential site and installed into an existing house being rehabilitated.

Intelligent Shock Mitigation & Isolation System through Applied RSPM Technology. To first perform the remaining development work to refine and upgrade RSPM control algorithms for Naval applications to meet a compelling need for Naval isolation technology; and secondly to scale up and test the fully integrated systems in mock-ups and simulators to verify the technology. The objective of the overall RSPM program is to create a commercially available family of ISMIS products through applied RSPM that will both meet the compelling need for Naval isolation technology and satisfy the uses of ISMIS in seismic protection of structures.

Light Scattering Measurement Techniques and Practices. To develop standard materials for verifying polarized BRDF measurements in the visible and infrared spectral region. Currently, there are no accepted standard materials for verifying Mueller matrix BRDF measurements in general, or for unpolarized scattering measurements in the infrared. Work performed will produce well a characterized sample of materials that can be theoretically analyzed to predict the polarized BRDF, which can be used to verify the experimental measurements.

Technical Assistance to CIT. The objective of this Agreement is to transfer technology from CDNSWC to those companies in the Commonwealth of Virginia that, through CIT, have requested technology assistance. It is expected that technology in the fields of acoustics, advanced materials, environmental technology, hydromechanics, machinery and ship technology will be of the most interest for Cooperative Research.

Centrifugal Casting Technology. The objectives of this Agreement are to:

1. Develop techniques for synthesis of remeltable TiC/bronze and/or WC/bronze or both, metal matriz composite ingots.
2. Develop centrifugal casting procedures.
3. Scale up ingot size from laboratory to production size, including centrifugal casting procedures from bench scale to large size castings respectively.
4. Produce wear resistant full size components such as cylinder liners, bearing races, gears, flywheels and others as need arises.
5. Commercialize the technology and the product for U.S. markets beyond Navy (and DoD) components and applications.

Resonance Apparatus. The objective of this Agreement is to obtain resonance apparatus evaluation of twelve samples covering a wide range of frequencies by the use of time-temperature superposition of data obtained in the kilohertz region as a function of temperature. These results will be analyzed for the insight possible into the molecular mechanisms responsible for the dynamic behavior. Of particular interest is to compare the data obtained with the resonance apparatus to the data obtained from

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commercial equipment for the same purpose. It is hoped that the potential advantages of using the resonance apparatus will be demonstrated by these measurements.

Technical Assistance to the University of Maryland Technology Extension Service. The objective of this Agreement is to transfer technology from CDNSWC to those companies in the State of Maryland that, through UMCP, have requested technology assistance. It is expected that technology in the fields of chemical processing, testing, manufacturing technology, safety, electronics and environmental technology will be of the most interest for Cooperative Research.

Discriminate Reduction Data Processing. The objective of this Agreement is to further develop the art of Discriminate Reduction Data Processing by developing and providing software which will approximately evaluate the speed dependence of computer generated error-affected data.

Ben Franklin Technology Center (BFTC). The objective of this Agreement is to transfer technology from CDNSWC to those companies in the Philadelphia metropolitan region that through the BFTC have requested such technology. It is expected that technology in the fields of Acoustics, Advanced Materials and Structures, Environmental, Machinery Systems, and Ship Technology will be of the most interest for Cooperative Research.

Design and Analysis of Antenna Systems. The objective of this Agreement is to cooperatively perform RDT&E in the fields of sensors and C4I systems, particularly antenna systems and low observable technology.

Tech Assistance to AAI/Manufacturing Services Division. CDNSWC will review the corrosion plan for AAI/Manufacturing Services Division, which is building electric transportation buses.

Dahlgren Division

Mine Countermeasure (MCM) - Through the MCM program, NSWCDD develops and implements new technologies to detect and identify mines in airborne, surface, and shallow water environments. Technologies include magnetics, acoustics, electro-optics, remote vehicles, and minesweeping.

Amphibious Warfare (AMW) - To support the Navy's amphibious warfare needs, NSWCDD develops LCAC and Amphibious Assault System interfaces; conducts shock, builder, and acceptance trials; and provides acquisition, in-service engineering, and life cycle management support.

Counterdrug Technology - As Executive Agent for the DoD Counterdrug Technology Development Program, NSWCDD works to enhance the effectiveness of the national counterdrug mission by providing new technology to the Defense and civilian forces engaged in counterdrug operations.

Chemical-Biological Warfare (CBW) Defense Systems - NSWCDD provides naval expertise for all aspects of CBW defense by supporting Navy and DoD decision-makers in developing CBW defense strategies and operational concepts, setting requirements, and ensuring requirements are met.

Solid State Technologies - The Solid State Group of NSWCDD engages actively in the understanding of the physical and chemical processes that occur in semiconductors. The Group has developed a new materials manufacturing process called compliant substrate engineering. Compliant substrate

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engineering is one of the most promising approaches to the systems integration of nanotechnology and conventional microelectronics. Such integration will accelerate the implementation of truly revolutionary devices made out of nanodevices, such as molecular computers to the fleet.

Standard Missile (SM) - As the SM Lead Laboratory, NSWCDD serves to ensure that missile designs meet Operational Requirements, that requirements are consistently allocated, and certifies SM performance in several key areas.

Naval Surface Fire Support (NSFS) - Per direction of Congress, the Navy established the NSFS program to embrace the full spectrum of science and engineering relevant to the development of state-of-the-art surface weapon technology. The NSFS program's objective is to develop long-range guns and missiles designed for maximum range and effectiveness that can be produced at the lowest possible cost.

Special Technology Countermeasures - As home to the Joint Program Office for Special Technology Countermeasures (JPO-STC), NSWCDD is responsible for providing CINCs, military services, and DoD mission planners with a systems analysis capability to identify critical infrastructure dependencies that, if disrupted, would impact military operations that are vital to national security.

Navy Operations Other Than War (OOTW) - NSWCDD's OOTW Technology Center is designated as the Navy focal point and clearinghouse for enabling technologies and innovative concepts that can be applied to Navy OOTW missions. The Center provides the invaluable service of matching the right technology solutions to the appropriate mission need and ultimately the user.

TOMAHAWK - NSWCDD provides real-time operational support and crew training from a unique facility containing ashore and afloat total system environments to ensure proper control and operation of the software. Provides end-to-end integration and validation of the surface ship TOMAHAWK Weapon System before its deployment.

Submarine Launched Ballistic Missile (SLBM) - NSWCDD contributes formidable expertise in the research, development, and support of fire control and targeting software for all SLBM weapon systems.

DD 21 - As a member of the DD 21 Program Office's Technical Team 21, NSWCDD provides systems engineering technical expertise in critical combat system, computing system, and total ship system engineering areas for the DD21 Surface Combatant. Also maintains the Collaborative Engineering Data Center (CEDC) - a central repository of all DD 21 programmatic and technical information.

AEGIS - NSWCDD provides lifetime support engineering for the CG-47 and DDG-51 class ships. Through the AEGIS Computer Center (ACC) the AEGIS fleet and community has available facilities and support services to generate, test, integrate, and deliver quality-assured AEGIS tactical, simulation, support, and training computer programs.

Maritime Special Operations - As lead laboratory and Systems Integration Agent for Naval Special Warfare, CSS NSWCDD has developed and provides in-service engineering agent functions for the SEAL Delivery Vehicle, the Swimmer In-Shore Navigation System, and the LAR V Underwater Breathing Apparatus.

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Diving and Life Support Systems - At the Coastal Systems Station, NSWCDD conducts fundamental research through full-scale development of underwater and surface life support equipment and systems.

Distributed Engineering Plant (DEP) - NSWCDD has developed the Distributed Engineering Plant (DEP) by linking eight (8) Navy shore-based CVN/AEGIS/DD/FFG/E2C/LHD facilities into a land-based Battle Group (BG). By networking the Navy's shore-based combat systems/C4I hardware and inserting system simulation and stimulation data, engineers identify and solve interoperability problems ashore well before the systems enter the operating forces. COMNAVSEA has decreed that no BG or its deploying combat system software loads shall be introduced into the Fleet without having been tested in the DEP.

Land Attack - NSWCDD is leading the systems engineering, coordinating the development of the elements, and integrating the Land Attack Warfare System for the Surface Navy.

ACTIVE COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (FY00)

Development of New Software Products Based on NSWCDD Supersonic Airflow Programs. The objective of this Task is to develop new software products embodying:

(1) Previously developed original work of NSWCDD on supersonic airflow programs embodied in the software package identified as "ZEUS"
(2) The derivative work embodying trade secret data received from Nielson Engineering & Research, Inc. (NEAR) making the software products more suitable for commercialization by NEAR.

Development of a New and Improved Launcher for the Shoulder-Launched Multi-Purpose Assault Weapon (SMAW). The objectives of this Task with CMS, Inc. are:

(1) To develop and transition to production the SMAW lightweight launcher
(2) To develop and transition to production a new SMAW spotter round with acceptable ballistics and lower production cost
(3) The successful transfer of the current SMAW technical data package
(4) To investigate and incorporate other system improvements, as appropriate.

Compliant Barium-Compound Substrate Technology for Chemically Deposited PbS and PbSe Monolithic Focal Plan Arrays. The objective of this CRADA with Sensarray Corporation is to develop an enabling technology that would allow the integration of infrared optical detector arrays and silicon electronic circuitry onto a single substrate. It should also have the capability of on-chip signal processing. The output of the sensors must be directly applicable to electronic decision-making and be commensurate with more complicated electronic processing for target detection and pattern recognition.

Technical Assistance to the University of Maryland's Technology Extension Service. To transfer technology from NSWCDD to those companies in the State of Maryland that, through the University of Maryland (College Park), have requested such technology. It is expected that technology in the fields of Devices and Sensors, Information and Systems Sciences, Advanced Data Processing Methods, Pulsed Power Systems Sciences, Simulation and Modeling, and Electromagnetic Environmental Effects will be of the most interest for Cooperative Research.

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Effort to Develop an Advanced Launching System (Raytheon Missile Systems Company). Design, fabricate and demonstrate the feasibility of an advanced launching system prototype. Prepare a development test plan that identifies all testing, procedures, pass/fail criteria, test sites, and number and configuration of the units to be tested. Prepare a system safety program that identifies the system safety organization; hazard identification, risk assessment process, tracking process, and resolution process; safety analysis requirements; safety testing requirements and establishes Weapons Systems Explosive Safety Review Board (WSESRB) reviews at appropriate milestones.

The Development of Low Threshold Multi-Point Initiators (Electronics Development Corporation (EDC)). Demonstrate the feasibility of using chip bridge detonators in multi-point initiator applications, resulting in a significant reduction in the threshold voltage requirements for future weapon systems. Develop, integrate, demonstrate, and evaluate multi-point initiated, low threshold Exploding Foil Initiators. The participants will provide personnel knowledgeable in the development of low threshold detonators and attachment techniques for Exploding Foil Initiators, using the NSWCDD test facility and test equipment.

Reverberation Chamber Program (Lindgren RF Enclosures, Inc.). Design, fabricate, and test a compact reverberation chamber and demonstrate the feasibility of using it operate down to the lower frequency limit of 80 MHz as specified in International Electrotechnical Commission (IEC) specification 1000-4-3.

Improved Naval Gun Technology (United Defense LP Armament Systems Division). Objectives:

(1) Model advanced gun systems concepts such as utilizing composite gun barrel materials, improving propellant charge technologies and advanced munition handling systems, and integrating advanced future gun systems work
(2) Provide cost modeling, production planning (process/methods) and pre-production plans for advanced gun systems
(3) Provide lessons learned information with respect to R&D gun system efforts.

Advanced Launching System Technology (United Defense LP Armament Systems Division). The objective is to support the development of advanced launching systems via computer modeling and simulation, system conceptual design studies, safety evaluations, the building of mock-up designs, and the use of test facilities.

Investigative Collaboration to Develop GUIScript Toolkit (Apogee Software, Inc.). The objective is to create a commercial extension to the Universal Client and GUIScript that provides a toolkit for Web developers.

White Oak Lab RDT&E (White Oak History Corporation). The objective is investigative research that will support the development of a technical anthology detailing significant accomplishments of a major Navy RDT&E site over a 50-year period.

Automation Technology Incremental Insertion System (General Dynamics Advanced Technology Systems). Incremental development and transition to production of decision support software, expert systems, information access and control software, and supporting Human Computer Interfaces that enable drastically reduced manning of surface ship tactical systems through improved situation awareness and dramatically improved operator decision aids.

CURRENT IMPORTANT PROGRAMS

Development of Advanced Launcher Concepts and Technologies (Lockheed Martin Launching Systems). Collaborate to design, fabricate, and demonstrate the feasibility of advanced launcher control systems, gas management systems, and survivability technologies. Specific tasks under this CRADA have not been established, but will be implemented using a task approval procedure involving the Partners. Tasking may include: computer simulations/modeling, electronic packaging, life cycle cost modeling, manning analysis, rearming trade studies, remote trigger, production planning, platform interface, survivability, safety evaluations, mock-up designs, use of test facilities, studies of rocket motors and warheads, and evaluation of canister materials.

The Effects of Radio Frequency (RF) Energy on Exploding Foil Initiators (EFIs) (EG&G Optoelectronics). The objective is to characterize the response of exploding foil initiators (EFIs) to high levels of radiated electromagnetic energy. Phase I: continuous-wave, swept-frequency illumination of instrumented EFIs/striplines at moderate field strengths to determine frequencies of maximum response. Phase II: testing of non-instrumented EFIs/striplines at the previously determined frequencies of maximum response at extremely high level (simulated) shipboard EMEs. Analysis: damage assessment and post-test functional firing verification of exposed EFIs.

The Development of Biological and Chemical Decontamination Agents (Cummins Industries, Inc.). The objective is to test decontamination agents and colloidal surfactants to design and produce a foam generating application system that can be used for military and civilian emergency response to intentional or unintentional releases of warfare hazardous chemical and biological agents.

The Development of Reactive Material for Ordnance Application (Thiokol Propulsion Group). NSWCDD and Thiokol will work cooperatively to manufacture and test a strength-enhanced Aluminum/Polytetrafluoroethylene (Al /PTFE) material for future use in selected Navy ordnance applications. Demonstrate Thiokol's capability to produce Al/PTFE spheres and selected fragment-shaped parts that are equivalent in mechanical properties and reactivity to parts that have been tested by NSWCDD. Develop methods for increasing strength of Al/PTFE-based reactive material, beyond that of the material that has been tested by NSWCDD.

Growth of Single Crystal Diamond Films on Compliant Substrates. (West Virginia Research Corporation) The objective is to demonstrate the growth of single crystal diamond thin films on commercially available silicon substrates that been modified to accommodate the lattice mismatch between the diamond and silicon crystals.

The Development of Semiconductor Devices & Sensors for Commercial and Military Interest (BTG International, Inc.).

(1) Develop sensors that incorporate the interface engineering technologies that are under development at NSWCDD currently and in the future
(2) Develop R&D relationships with key semiconductor industry companies that will collaborate with NSWCDD/BTG to further develop the technologies with a commercial focus
(3) Develop commercialization pathways for the products and technologies jointly developed
(4) Enable the manufacture of commercially available products incorporating the NSWCDD technologies, and engage semiconductor industry collaborators for the R&D and commercialization program.

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Development of Hybrid Dive/Gas Mask (Navy Experimental Diving Unit and Diving Systems International). The NEDU and DSI entered into this agreement in order to design, construct, and perform engineering analysis of a prototype Hybrid Dive/Gas Mask. DSI intends to manufacture and market this device if it proves successful. In addition to the commercial application of this concept to the private sector, unique applications to the SEAL community have been identified.

Submersible Boat Development and Commercialization (CSS and Stidd Systems, Inc.). The objective of this CRADA is design, fabricate, develop, integrate new componentry; improve and test a second generation SEAL Submersible Boat for commercial development and marketing purposes. Two previously issued patents (numbers 5,377,613 and 5,632,659) are licensed in support of this CRADA.

Development of a Cold Water Regulator (Navy Experimental Dive Unit and Scuba Technology Unit and Scuba Technology, Inc.). The objective of this CRADA is to develop an open circuit dive regulator that meets or exceeds the Navy requirements for cold water diving.

Hazmat Protection Ensemble (Unconventional Concepts, Inc.). The purpose of this CRADA is to design, develop, and manufacture a hazardous material protection ensemble designed to provide constant and continuous situational awareness and battle space management capabilities. The focus will not be on protective capabilities, but on the integration of communications and information management/display capabilities into existing equipment.

Integrated Diver Display (American Underwater Products, Inc.). The objective is to develop a prototype diver's integrated display mask. The display mask will incorporate RF technology, pressure transducers, miniature liquid crystal displays, and custom optical lenses to present a magnified image of the diver's depth, dive time, and tank pressure.

Night Vision Compatibility Study (Bath Iron Works Corp.). The objective is to analyze total lighting and control requirements for all aspects of well deck/LCAC (Landing Craft Air Cushion) operations with and without Night Vision Devices (NVD).

Underwater and Terrestrial Archaeology (University of West Florida). The objectives are to provide specific information concerning the spatial extent of archaeological sites on NSWCCSS federal property and to provide support for University of West Florida (UWF) summer field schools.

Flexible, High Pressure, Underwater Pipe RDT&E (Wellstream, Inc.). Develop collapse resistant flexible pipe with the aid of verification testing of facilities located at the Coastal Systems Station, Panama City, FL. Conduct environmental testing of Wellstream deepwater flexible pipe construction and sealing designs. Develop, integrate, demonstrate, and evaluate high pressure sealing techniques for flexible tubing under significant stresses due to internal/external pressure and those stresses due to bending of the tubing.

Laser Evaluation for Display Application (Florida Atlantic University). The spectral and power characteristics of the Spectral Diode Laboratory's red, green and blue lasers supplied to FAU by NSWCDDCSS will be quantified and monitored for use in the development and evaluation of laser-based projection display concepts. Integrate red, blue, and green lasers into projection display technology to evaluate performance capabilities and design constraints as a potential commercial application of the contributing technologies.

CURRENT IMPORTANT PROGRAMS

Breaching Technology (Primex Technologies, Inc.). CSS and PRIMEX will jointly identify potential problems, potential solutions, and proposed concepts in the area of explosive and non-explosive breaching and clearance technologies. CSS will provide modeling and simulation analysis and technical assessment of concepts developed by PRIMEX. As partners, when necessary, CSS and PRIMEX will conduct field validation tests of proposed concepts. CSS will provide expertise in field testing at government facilities, and PRIMEX will provide new prototype hardware for field testing. PRIMEX will market proven concepts for military and humanitarian demining.

Coastal Operations Initiative (Coastal Operations Insitute). Identify and address existing and emerging problems in coastal operations. Develop technical and systematic approaches to solving the wide variety of problems confronted in the coastal arena. Perform research, engineering and technology efforts commensurate with the resources provided from national, state, and local organizations, and agencies. Provide technical expertise in the form of research scientists and engineers to design, direct, and/or conduct studies addressing problems in coastal operations. Support the development of proposals to both public and private agencies that address studies relevant to coastal operations.

LASH-MCM Brassboard System Demonstration (Science and Technology International). Conduct field/flight measurements against "real world" sea and landmine targets/target fields to allow evaluation of LASH-MCM Brassboard system performance, data acquisition and post-test signal processing. Collect, analyze, and process data in conjunction with Fleet Battle Experiment - Hotel (FBE-Hotel) on a non-interference basis with the exercises.

In addition to the above, NSWCDD issued 50 patents to NSWC Dahlgren Division employees in FY00.

Indian Head

The following are new Cooperative Research and Development Agreements (CRADAs) for the NSWC - Indian Head Division (IHDIV) for 2000:

(1) **Technical Assistance to the University of Maryland at College Park's (UMCP) Technology Extension:** The purpose of this CRADA is to facilitate the transfer of technology from IHDIV to Companies in Maryland, in particular small businesses, who request technical assistance through UMCP's Technology Extension Service (TES). The Division possesses leading edge technical skills in specific areas that are critical to developing and maintaining a competitive world position for many U.S. companies.

(2) **Research and Development of Rapid, Organic Stand-off Technologies for Breaching Surf Zone and Beach Zone Mines and Obstacles:** The intent and nature of the work done under this CRADA is for Primex Technologies, Inc. and IHDIV to conduct research and development on a concept that would lead to employing innovative IHDIV payloads using two different Primex delivery vehicles: the 155-mm Advanced Gun System (AGS) projectile and the Tactical Munitions Dispenser (TMD). Two payloads will be investigated: chemical, pyrotechnic, or reactive material penetrators/flechettes and a continuous rod warhead (CRW). The penetrators will be designed to neutralize mines on the beach or the water. The CRW warhead will be used to neutralize obstacles on the beach. The AGS precision-guided projectile will deploy both payload types, while the TMD will be used to deploy penetrators.

CURRENT IMPORTANT PROGRAMS

(3) **Research and Development on Concepts to Support Natural Hazards Abatement, Chemical/Biological Decontamination, and Hazardous Storage Tank Drainage:** The technical objective of this CRADA is for IHDIV and Pennant Engineering Technology Inc. to conduct research, development, testing, and evaluation leasing to the development of one or more systems to assist rescue personnel in controlling natural hazards such as forest fires or avalanches. Additional efforts will also focus on new support equipment to drain hazardous storage tanks safely and heat decontamination water supplies rapidly.

(4) **Research and Development of Stand-off Delivery of Mine and Obstacle Clearing Payloads from 5-Inch Navy Guns:** The technical objective of this CRADA is for IHDIV and Science Applications International Corporation to conduct research leading to the development of a countermine and counter-obstacle system. This concept is being developed for a family of two 5-inch mine warfare projectiles, fired from the Mk 45 Mod 4 5-inch, 62-caliber naval gun. Two payload types under development by the Division will be investigated for incorporation into the system. One type of projectile carries a payload of surface-contact, chemical-filled penetrators to destroy mines in both the surf and beach zones of littoral warfare. A second type carries a continuous rod warhead payload designed to destroy light-to-medium, surface-based obstacles in the beach zone.

Ten Most Important Programs at Indian Head

(1) **Assault Breaching:** RDT&E for Navy and Marine Corps Mine Countermeasures (MCM) including: distributed explosives technology (DET), demonstrative/advanced countermeasure, surf zone MCM, shallow water MCM, and Explosive Neutralization Advanced Technology Development (ENATD).

(2) **NSFS:** R&D of new propellants for propulsion and projectiles for the Navy's extended range guided munitions in support of Naval Surface Fire Support Systems (NSFS).

(3) **IMAD-HE:** Insensitive munitions advanced development for high explosives for all Navy weapons.

(4) **MEMS (Microelectromechanical Systems):** RDT&E efforts in support of Navy fuze/safe & arm devices for future underwater weapons.

(5) **RFID (Radio Frequency Identification)/MEMS Sensors:** RDT&E effort in support of new technologies for predicting safe service-life of ordnance.

(6) **Reactive Materials:** Synthesis and characterization of reactive materials for air and surface, undersea, and mine warfare warhead applications, and R&D in use of reactive materials for neutralization of chemical/biological stores.

(7) **GEM (Green Energetics Materials):** R&D of new energetic materials which can be reused and manufacturing processes that are environmentally cleaner. GEM program will reduce life cycle costs for ordnance.

(8) **CAD/PAD:** Tri-Service RDT&E support for cartridges, cartridge and propellant actuated devices, and aircrew escape propulsion systems.

(9) **High Performance Explosives:** R&D of new explosives for underwater, air and surface weapons.

(10) **Continuous Processing:** Development of continuous processing technology for affordable manufacturing of energetics.

EQUIPMENT/FACILITIES

Carderock Division

West Bethesda Site: David Taylor Model Basin Complex. Maneuvering and Seakeeping Basin. Rotating Arm Basin. Radio Controlled Model Facility. Circulating Water Channel. 24-inch and 36-inch Cavitation Channels. Dynamic Control System Simulator. 140-foot Towing Basin. Hydrodynamic / Hydroacoustic Technology Center. Ship Materials Technology Center. Structural Evaluation Laboratory. Deep Submergence Pressure Tanks. Shock Trials Instrumentation. Explosions Test Pond. Simulation, Acoustic Data Analysis Center and Acoustic Trials Instrumentation. Electro-Magnetic Signatures Facility. Aerodynamic & anechoic wind tunnels. Environmental Science & Shipboard Systems Lab. Strategic Planning and Analysis Research Center. Data and Image processing systems. Small-Scale Fire research and air contamination facility.

Carderock Philadelphia Site: Machinery Systems Silencing Lab. Advanced Electrical Machinery Lab. Machinery Technology Development Facility. Submarine Fluid Dynamics Facility. Electric Power Technology Lab. Non-CFC Systems Facility. Full-scale IPMP (SSN-21) steam propulsion land based test site. Full-scale LSD-41 diesel propulsion land based test site. Full-scale DDG-51 gas turbine land based test site. Full-scale electric drive/machinery module land based test site. Full-scale gear metrology and calibration lab. Full-scale air compressor test site. Full-scale submarine life support test site. Full-scale Air Conditioning and Refrigeration test site. Full-scale submarine generator test site. Full-scale submarine ship service generator test site. Full-scale conveyor and elevator test complex. Full-scale submarine mast bending test facility. Full-scale submarine periscope/antenna test sites. Full scale submarine buoy communication test site. Chemistry and metallurgy lab. Full-scale gravimetric flow calibration lab. Test operations. Full-scale Volumetric Flow Calibration Lab. Test Operation and Analysis Center. Analysis and control center. Full-scale steam propulsion testing complex.

Carderock Division - Bayview, ID: Acoustic Research Detachment
Carderock Division - Bremerton, WA: Fox Island Acoustic Laboratory
Carderock Division - Ketchikan, AK: Southeast Alaska Acoustic Measurement Facility
Carderock Division - Fort Lauderdale, FL: South Florida Ocean Measurement Center
Carderock Division - Cape Canaveral, FL: Research Vessel Hayes
Carderock Division - Memphis, TN: Large Cavitation Channel (LCC)
Carderock Division - Norfolk, VA: Combatant Craft Engineering Detachment
Carderock Division - Patuxent River, MD: Combatant Craft Special Trials Unit
Carderock Division - Panama City, FL: Lauren & Athena Research Vessels

Dahlgren Division

Dahlgren Site:

Chem-Bio Sciences Complex - is used for research in support of molecular computing and the effects of chemicals on various materials. The complex includes the following state-of-the-art science labs: Molecular and Cellular Biology Lab, Molecular Computing Spectroscopy and Photonics Lab, Chem-Bio Instrumentation and Thermal Analysis Labs, and general chemistry labs.

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SLBM Weapons Control Facility - is used for the development and testing of SLBM weapons control software, fleet problems investigation, fleet procedures development, technology and obsolescence studies and production and quality control of fleet media (i.e., magnetic media containing weapons control software and data and strategic targeting data).

Scientific and Engineering Computing Complex - Provides high performance computing capability for science and engineer personnel of the laboratory. The equipment available includes a CRAY Y-MP2E supercomputer (up to secret level), and a CRAY EL98 entry-level computer (unclassified).

Aegis Computing Center - This is the designated computer program Lifetime Support Engineering (LSE) facility for supporting CG-47 and DDG-51 AEGIS class ships. The facility is used to support AEGIS ships during the construction, operation, and modernization phases by providing the tactical computer programs and training exercises needed to make AEGIS ships and sites operational.

Cooperative Engagement Capability (CEC) Tower - The CEC Tower at Dahlgren, VA is a part of the CEC East Coast Land Based Test Network (LBTN). The tower is connected to the Aegis Computer Center, host of the AEGIS Combat System, via a new Tactical Protected Distribution System (TPDS). TPDS provides interconnectivity between tactical systems across the Dahlgren Base so that they may be tested before deployment. The tower provides an external radio frequency link to other CEC sites to perform land-based testing in support of NSWCDD roles as CEC Certification Agent and Software Support Activity.

Search and Track Sensor Test Site (STSTS) - The STSTS allows over the water testing of individual Radio Frequency (RF) and Electro-Optical sensors or complex sensor systems during and/or at the completion of their development cycle. This facility is used in conjunction with the Potomac River Test Range (PRTR) and provides an 80,000-yard over the water, littoral, laser certified, instrumented range.

Potomac River Test Range (PRTR) - The PRTR is a complex of land and water ranges used for the test and evaluation of live or inert ordnance, weapon systems, and weapon systems components. The water range is approximately 3 nautical miles wide and sixteen nautical miles long.

Panama City Site:

Mine Warfare (MIW) Research and Engineering Complex - is a special facility that includes the Airborne Mine Countermeasures Facility, The Mine Exploration Facility, the Countermeasures Evaluator, the Computation and Analysis Lab (CSEL), and the MIW Fleet Support module, and the Sensor Development Complex. This facility is used to perform almost all US Navy Research and Development (R&D), Test and Evaluation (T&E), acquisition support and in-service engineering (ISE) of mine warfare systems, including mines and mine countermeasures.

Airborne Mine Countermeasures Complex (AMCM) - This special facility is required to conduct research and development, test and evaluation, and in-service engineering activities for the AMCM systems. The complex supports the aircraft and AMCM systems required to conduct full-scale testing of AMCM systems for quick response to operational airborne MCM squads.

Mine Exploitation Complex - This facility is used to perform R&D, T&E, acquisition support, and ISE of Mine Warfare Systems. The complex is an integrated combination of special facilities designed for

EQUIPMENT/FACILITIES

testing and analyzing the vulnerability of Air and Surface Mines Warfare platforms and systems, Amphibious Warfare systems, and Special Warfare systems to foreign and U.S. mines.

Amphibious Warfare Engineering and Test complex - This complex consists of five permanent buildings and one temporary structure. The complex is used to conduct the majority of R&D, T&E, acquisition support, and ISE for Amphibious Warfare systems. The major buildings are the LCAC Hanger/Ramp Facility, the Amphibious Warfare Building, and three engineering support buildings.

Mine Warfare Test and Training Range - This range is located along the Gulf of Mexico and supports the training for the operation, test and evaluation (T&E) of those systems and technologies utilized primarily in mine countermeasures (MCM), amphibious, and special warfare operations. This support consists of tracking, positioning and signature measurements including acoustic, magnetic, and pressure.

Indian Head Division:

IHDIV has extensive facilities for research, development and testing of energetic materials and energetic components. These facilities are capable of taking nearly any energetic material from laboratory scale through full-scale engineering development. Some of the major facilities are:

Explosive Test Chambers - highly instrumented facilities capable of testing up to 50 lbs of high explosive in a very controlled environment. These facilities are used to conduct research into detonation science and for development of advanced materials and warheads.

Energetics Formulation and Development - includes a variety of facilities capable of processing all classes of energetic materials in quantities from a few grams up to thousands of pounds. Additionally, design, modeling, and simulation capabilities are available to develop advanced warhead, rocket motor and gun propulsion concepts and designs that can be made in the extensive processing facilities. The Continuous Processing Development Facility is a state-of-the-art facility to develop advanced processing technology for energetic materials using a twin screw mixer/extruder. This facility can process most solid energetic materials at rates up to approximately 100 lbs/hr. The flexibility to handle multiple material feeds and materials with a very wide range of rheologies, coupled with extensive instrumentation makes this facility unique in the ability to develop future generations of energetic materials and components, affordably.

Energetic Chemicals Synthesis and Scale-up - a collection of laboratories and pilot scale chemical processing facilities that are used to develop next generation energetic molecules. Batch and continuous chemical reactors, distillation, extraction, and other chemical operations are easily reconfigureable to scale-up new energetic chemicals. Extensive laboratory synthesis and analytical equipment complements the scale-up capability in a way that a new chemical can be taken from the gram scale through to a scale of hundreds of pounds quickly and efficiently.

Rocket Motor Testing - facilities are capable of evaluating many aspects of rocket motor performance. Static testing and environmental test chambers are routinely used to provide data on motors in development as well as to verify performance of fleet assets. A unique capability to conduct a functional ground test of the Tomahawk missile allows the performance of a missile to be monitored throughout its entire flight cycle without the missile ever leaving the ground.

EQUIPMENT/FACILITIES
Chemical and Physical Analysis - laboratories are used extensively to support the research and development of new energetics. Extensive state-of-the-art instrumentation and techniques are used to evaluate parameters such as purity, composition, structural properties, and safety, as well as to evaluate aging and service life of fielded systems. Environmental analysis is also a key component of this capability.

Naval Surface Warfare Center
Arlington, VA 22242-5160
(703) 602-0632

Commander: RADM M.G. Mathis
Technical Director: Dr Daniel M. Viccione.

*FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	3.833	N/A	0.024	3.857
6.1 Other	6.580	N/A	5.959	12.539
6.2	66.857	N/A	49.704	116.561
6.3	49.475	N/A	81.337	130.812
Subtotal (S&T)	**126.745**	N/A	**137.024**	**263.769**
6.4	238.778	N/A	169.913	408.691
6.5	90.639	N/A	71.652	162.291
6.6	24.333	N/A	24.747	49.080
6.7	47.431	N/A	51.955	99.386
Non-DOD	0.000	N/A	0.000	0.000
TOTAL RDT&E	**527.926**	N/A	**455.291**	**983.217**
Procurement	293.448	N/A	358.857	652.305
Operations & Maintenance	300.354	N/A	224.980	525.334
Other	159.422	N/A	120.244	279.666
TOTAL FUNDING	**1281.150**	N/A	**1159.372**	**2440.522**

*MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	17.600

*PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	1	42	214	257
CIVILIAN	354	5179	4267	9800
TOTAL	**355**	**5221**	**4481**	**10057**

*SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	4864.190	**REAL PROPERTY**	927.460
ADMIN	1364.934	** NEW CAPITAL EQUIPMENT	54.549
OTHER	7292.887	**EQUIPMENT**	537.497
TOTAL	**13522.011**	** NEW SCIENTIFIC & ENG. EQUIP.	12.736
ACRES	**9412**	** Subset of previous category.	

**As a result of applying the In-House RDT&E Activity criteria at the division or major site level (see NOTE on page 3-1), NSWC Port Hueneme Division, Crane Division, and NWAS Corona data is not included in the FY2000 report.*

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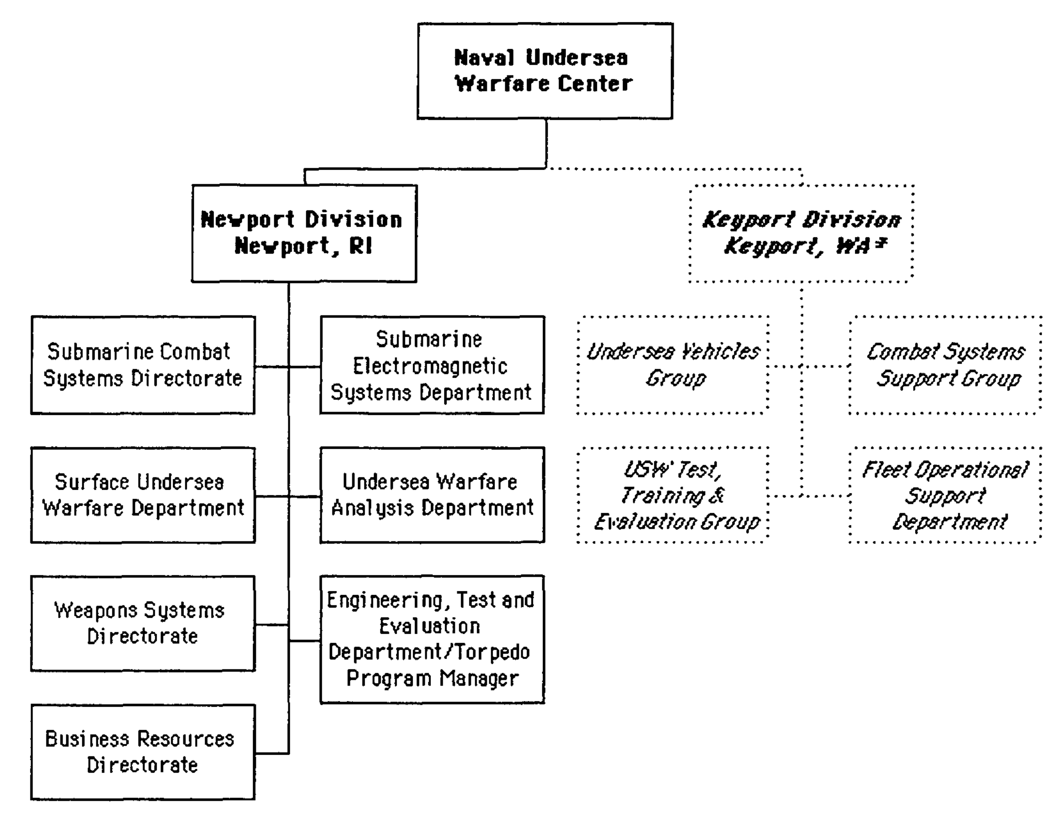
Naval Undersea Warfare Center

FY2000 Abbreviated Functional Chart - Technical Organizations



As a result of applying the In-House RDT&E Activity criteria at the division level (see NOTE on page 3-1), NUWC Keyport Division data is not included in the FY2000 report.

Naval Undersea Warfare Center
Newport, RI 02841-1708
(401) 832-6761

Commander: RADM Charles B. Young
Technical Director: Dr. John E. Sirmalis

MISSION

The Naval Undersea Warfare Center (NUWC) Mission promulgated by OPNAVNOTE 5450 Ser 09B22/1U510577 dtd 23 Dec 91 is as follows:

'Operate the Navy's full spectrum research, development, test and evaluation, engineering, and fleet support center for submarines, autonomous underwater systems, and offensive and defensive weapon systems associated with undersea warfare.'

Technical Leadership Areas:
As assigned by SECNAVINST 5400.16 of 18 December 1992, NUWC provides the Navy with leadership in:

- Undersea Warfare Modeling and Analysis
- Submarine Combat and Combat Control Systems
- Surface Ship and Submarine Sonar Systems
- Submarine Electronic Warfare
- Submarine Unique On-Board Communications Systems and Communications Nodes
- Submarine Launched Weapons Systems (except strategic ballistic missile systems, cruise missiles and related systems)
- Undersea Ranges
- Torpedoes and Torpedo Countermeasures
- Submarine Vulnerability and Survivability (except Hull, Mechanical & Electrical Ship's Equipment -- HM&E)
- Undersea Vehicle Active and Passive Signatures (except HM&E)
- Submarine Electromagnetic, Electro-optic and Non acoustic-effects Reconnaissance, Search and Track Systems

CURRENT IMPORTANT PROGRAMS

SCIENCE AND TECHNOLOGY

NUWC conducts a comprehensive Science and Technology program in support of its mission that spans In-House Laboratory Independent Research (ILIR), Basic Research, Applied Research and participation in Advanced Technology Demonstrations. Current emphasis areas include:

- Submarine Combat Control - contact management, weapon targeting, engagement planning and advanced information management concepts, training automation.
- Submarine/Surface Ship Sonar - shallow water active classification, high gain systems, active surveillance systems, full signature processing, deployable surveillance systems.
- Torpedoes - propulsion and control systems, hydrodynamics/drag reduction, supercavitating technology noise reduction/acoustics, countermeasure technologies, UUV's, launchers, and advanced concepts.
- Submarine Communications - communication at speed and depth, mast antenna technology.

CURRENT IMPORTANT PROGRAMS

SUBMARINE SONAR

- AN/BQQ-5
- AN/BQG-5 Wide Aperture Array
- TB-16F, -23 and -29 Submarine Towed Arrays
- Submarine Sonar Advanced Development
- AN/WLY-1 AN/WLR-9
- New SSN Sonar Subsystem
- AFTAS
- RATTRAP
- Acoustic Rapid COTS Insertion
- Sonar Advanced Development
- Transducer Tech Direction/Support Program
- AN/BSY-1 Acoustics
- Submarine Ancillary Sonar Systems
- Affordable Array Technology (ATD)
- Ultra Thin Line Array
- Thin Optical Towed Array
- Acoustic Comms (ATD)
- Submarine Safety (SUBSAFE) Program
- Multi-Chip Module Laboratory
- Towed Systems ISEA
- Macintosh-Based Digital Signal Processor (MACDSP)
- Multi-line Towed Array (MLTA)
- Conformal Acoustic VElocity Sensors (CAVES)
- High Frequency Active (HFA)
- Advanced Processor Build Program
- Multi-purpose Acoustic New Technology Insertion System (MANTIS)

SURFACE SHIP SONAR AND ASW SYSTEMS

- AN/SQQ-89 ASW Combat System
- Multistatic Sonar
- Surface Ship Torpedo Defense
- AN/SQR-19 Tow Array Sonar
- AN/SQS-53 A,B,C,D Active Hull Sonar
- AN/SQQ-28 Sonobuoy Processor
- KINGFISHER
- Echo Target Classifier
- Shallow Water Active Detection Classification
- Tech Team 21
- DD-21
- Lightweight Broadband Variable Depth Sonar
- Towed Active Receiving System (TARS)
- Sonar Insitu Mode Assessment System (SIMAS)

CURRENT IMPORTANT PROGRAMS

- Weapon System Accuracy Trails (WSAT) Program
- ASW Systems Consolidated Operability Test (SCOT) Program
- AN/SQQ-89 Support Team
- Advanced Undersea Warfare Concept (AUSWC)

SUBMARINE COMMUNICATIONS, ELECTRONIC WARFARE SUPPORT MEASURES (ESM), ELECTRO-OPTICS SYSTEMS/PERISCOPES

- Submarine Connectivity
- On-Hull Extremely Low Frequency (ELF) Antenna
- Submarine High Data Rate (HDR) Antenna System
- Large Aperture Multifunction C4ISR Mast
- OE-538 Multifunction Mast Antenna
- Submarine Integrated Antenna System (SIAS)
- Extremely Low Frequency (ELF) Communications
- Navy Extremely High Frequency (EHF) Satellite Communication Program (NESP)
- Submarine Communication Support System (SCSS)
- Integrated Electronic Support Measures (ESM) Mast (IEM)
- AN/BLQ-10 Submarine Electronic Warfare Support System
- AN/WLR-8 High Probability of Intercept (HPI) Receiver
- AN/BVS-1 Photonics Mast
- Electro-Optic Sensor Development and Acquisition
- Submarine Periscopes Program
- Submarine Shipboard Electromagnetic Compatibility Improvement Program (SEMCIP)
- EMC Advisory Boards (EMCAB)
- Plasma Excitation
- UHF Medium Data Rate Asymmetric Communications System

VIRGINIA, SEAWOLF, LOS ANGELES, AND TRIDENT CLASS SUBMARINE COMBAT AND COMBAT CONTROL SYSTEMS

- VIRGINIA
- AN/BSG-1 Weapon Launching System
- AN/BSY-2, AN/BQG-5 Submarine Combat System
- Combat Control Systems MK 2
- SEAWOLF Non-Propulsion Electronics
- Trident Command and Control System
- Missiles: Combat Control
- Module Test and Repair Program
- Trainers
- Sensor Performance Computer Based Tactical Aids
- CCS Mk1 C4.2V2A
- Advanced Tomahawk Weapon Control System
- Submarine Fleet Mission Program Library
- Tactical Control Program

CURRENT IMPORTANT PROGRAMS

UNDERSEA WARFARE ANALYSIS

- USW Vision
- TRIDENT SSGN Marginal Utility Assessment
- Capabilities for the Navy After Next
- Submarine System Engineering and Analysis
- USW Knowledge Management
- Intelligence Data Assessment
- Foreign Technology Analysis
- Modeling and Simulation Improvements
- Anti-Submarine Warfare Investment/Assessment
- Cost Analysis
- Integrated Warfare Architecture Requirements

DEVELOPMENT OF TRAINING, T&E, AND LOGICAL RANGES

- AUTEC Hydrophone Replacement Program (AHRP)
- Tri-Service Signature Measurement and Database System (TSDADS)
- Pinger Program
- Undersea Battlespace (USB)
- East Coast Shallow-Water Training Range (ECSWTR)
- Atlantic Fleet Weapons Test Facility Hydrophone Replacement
- Test and Training Enabling Architecture (TENA)
- Synthetic Environment Tactical Integration (SETI)
- Land Sea Vulnerability Test Complex (LSVTC)
- Underwater Range Data Communications Systems (URDC)
- Foundation Initiative - 2010 - Test and Training Enabling Architecture
- Offboard Advanced Systems Stimulus (OASIS)
- Distributed Engineering Plan (DEP)
- Soft Impact Location Capability (SILC)

SUBMARINE, SURFACE SHIP AND AIR LAUNCHED TORPEDOES, TORPEDO/SONAR COUNTERMEASURES, UUVS

- Torpedo Mk 48/Mk 48 ADCAP Program
- Torpedo Mk 50 Program
- Torpedo Mk 46 Program
- Torpedo Mk 54 (Lightweight Hybrid Torpedo) Program
- Torpedo Mk 46/Mk 48 FMS Program
- Torpedo Alternate Fuels Program
- CBASS Program
- ISLMM Program
- Torpedo Test Equipment Programs
- Mk 30 ASW Target Program
- Near Term Mine Reconnaissance System Program

CURRENT IMPORTANT PROGRAMS

- Long Term Mine Reconnaissance System Program
- ONR UUV Program
- ADC Mk 2/3/4 Countermeasure Program
- Affordable Common Countermeasure Program
- Adaptable High Speed Undersea Munitions

SUBMARINE MISSILES AND SUBMARINE/SURFACE PLATFORM SYSTEMS

- Submarine-Launched Tomahawk Cruise Missile Integration
- Encapsulated Harpoon Weapon System (FMS)
- Submarine Missile Simulators
- Submarine Torpedo Tubes
- SSN-21 Launcher Systems
- Turbine Pump Ejection Systems
- Submarine Weapon Handling
- SSN-688 Vertical Launch System
- Surface Ship Torpedo Tubes
- Virginia Class Launcher Systems
- Submarine External Countermeasure Launchers
- Submarine Internal Auxiliary Launchers
- Elastomeric Ejection System
- Submarine Advanced Launch Technology
- SSGN Program

TECHNOLOGY TRANSFER

NUWC conducts an extensive technology transfer program that is structured to make technology developed for defense purposes available to the academic and industrial communities through development of partnerships that benefit NUWC and the Navy. The main mechanics for technology transfer are:

Patent Program - NUWC operates a highly efficient patent program believed to be the most productive in the U.S. government (patents per scientist/engineer). In FY00, 184 invention disclosures were recorded, 101 patent applications were filed, and 110 patents were issued or allowed (106 patents and 4 classified allowances [D-10]). Some significant examples are:

- No. 5,985,523 Method for irradiating patterns in optical waveguides containing radiation sensitive constituents
- No. 5,996,630 System for suppressing cavitation in a hydraulic component
- No. 5,999,893 Classification system and method using combined information testing
- No. 5,983,067 Method and apparatus for simulating cross--correlation coefficients in a multipath sonar system
- No. 6,105,015 Wavelet-based hybrid neurosystem for classifying a signal or an image represented by the signal in a data system
- No. 6,118,066 Autonomous undersea platform
- No. 6,072,928 Tow cable with conducting polymer jacket for measuring the temperature of water column

CURRENT IMPORTANT PROGRAMS

- No. 6,028,823 Geodetic position estimation for underwater acoustic sensors
- No. 6,118,407 Horizontal plasma antenna using plasma drift currents.

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRADAs):

- Lockheed-Martin - Explore and exploit massively parallel processing as applicable to sonar processing
- MedAcoustics, Inc. - Demonstrate signal-processing algorithms to process acoustic signals within the cardiac cycle
- Precision Signal, Inc. - Develop state-of-the-art equipment to map deep- and shallow-water ocean floors
- General Dynamics/Electric Boat Division - Further the development of Computational Fluid Dynamics to meet current and future Navy needs
- Connecticut Municipal Electric Energy Cooperative - Investigate electric vehicle electromagnetic interference, measurement and mitigation
- University of Maine - Develop a method of predicting the deformation of nets deployed in an ocean environment
- Lucent Technologies - Develop ultra-thin array technology
- Yale University School of Medicine - Bio-medical model development
- Loctite Corporation - Material property measurement
- Draper Laboratory - Co-development of unmanned underwater vehicle technology
- Foster-Miller, Inc. - Demonstrate low-cost, expendable bottom-crawling vehicles for ocean-bottom explorations
- Public Service Electric and Gas Co. - Material development, testing and evaluation for shielding capability in electromagnetic fields
- Rhode Island Technology Transfer Center - Technical assistance to Rhode Island's technically-based companies
- CytoTheraputics, Inc. - Prototype packaging for medical devices using stereolithography
- Westfall Manufacturing Co. - Design verification and representation of a static fluid mixing device for water treatment processing
- Niche Medical, Inc. - Assistance in the design of a surgical smoke plume collector
- Deep Creek Technology, Inc. - Assistance with the integrated diagnostics support system
- Michigan State University - Development and application of controllable fluids
- Automata, Inc. - Assistance with the integrated diagnostics support system
- Dr. Alan Semine - Medical image processing for breast cancer
- Flight Safety Technologies, Inc. - Modeling and simulation of the acoustic signature of atmospheric disturbances
- BENTHOS, Inc. - Transfer and commercialize the THAMES acoustic measurement system software
- D.G. O'Brien - Underwater Test and Training Ranges - Development of a family of standard cable seals for use in terminating marine cables on the Navy's underwater test and training ranges
- Madison Technology International - Development of a family of high performance preamplifier/signal conditioners

CURRENT IMPORTANT PROGRAMS

- Yale Medical School - Bio-Medical Model Development - Develop constitutive formulation and mathematical representation for several cardiac tissues including anisotropic structures with time dependence
- Loctite Corporation - Acoustic Material Measurements - Determine the acoustic impedance of various candidate materials as a function of frequency and adhesive related structural boundary conditions

EDUCATION PARTNERSHIP AGREEMENTS (EPA's):

- Oceansciences, Inc. - to provide undersea science and technology educational guidance and assistance for an ocean sciences camp and museum to further math and science education.
- The University of Massachusetts/Dartmouth - to aid in the undersea science and technology education of students and faculty.
- Yale University - to aid in the fluid mechanics, acoustics, and mathematics education of students and faculty.
- The University of Rhode Island - to aid in the ocean science, engineering, computer science and engineering, mathematics, management, and statistics. technology, and policy applications of these disciplines to encourage student interest in these areas.
- The University of Massachusetts/Lowell, Institute for Plastics Innovation - to encourage students interest in the low-density extruded plastic materials applications of their individual disciplines.
- Rutgers, the State University of New Jersey - to aid in the ocean science, engineering, technology, and policy applications of these disciplines to encourage students interest in these areas.
- Florida Atlantic University - to aid in the education of students and faculty in ocean and systems engineering.
- Bryant College - to aid in the development of future leaders and managers through business management education via Distance Learning.
- Carnegie Mellon University - to provide software engineering education to students using new Distance Learning technology.

EQUIPMENT/FACILITIES

The Naval Undersea Warfare Center maintains and continuously improves numerous facilities designed to support the Research, Development, Test, and Evaluation of Undersea Warfare (USW) systems. These facilities include:

SONAR COMPLEX. This complex is a unique set of 6 facilities that include platform independent and federated laboratories and robust simulation and stimulation used to explore the underlying science and technology common to submarine and surface ship sonars. These facilities encompass the research, development and test of acoustic sensors, transducers, and arrays for use in tactical, calibration and standards applications at sites ranging from laboratory test beds and large scale pressure vessels to inland lakes and ponds. This complex provides the Navy with the capability to explore the technologies and science associated with transduction materials, fiber optics, environmental acoustics, and measurement and analysis techniques, leading to development of hull-mounted, towed, and expendable sensors and arrays. Sonar systems laboratories consist of specialized sites for the investigation of signal processing, operator displays, detection and classification algorithms, acoustic communication, acoustic

EQUIPMENT/FACILITIES

intercept, system architecture, onboard trainers, and commercial off-the-shelf applications utilizing robust simulation/stimulation capabilities to perform system evaluation, performance analysis and life cycle support.

SUBMARINE LAUNCHER SYSTEM TEST AND EVALUATION COMPLEX. This complex is a unique array of 8 major facilities dedicated to the full spectrum support of submarine weapon and countermeasure launcher programs. The facilities provide the capabilities for evaluating new launcher developments and improvements, land-based acceptance testing, and troubleshooting Fleet problems. The Transient Flow Loop and Transient Flow Impeller Test Facility are the only known facilities in the world capable of conducting hydrodynamic and hydroacoustic tests of transient flow. The Submarine Launcher System Test Facility replicates full-scale launch systems on SSN-688 and SSBN-726 class submarines and is capable of firing dummy weapons at all submarine depths. Dual ejection capability allows for concurrent, side-by-side firing comparisons of any two current or future candidate ejection systems. The Advanced Submarine Launcher Facility (ASLF) replicates the full-scale launch system on SSN-21 and Virginia class submarines, and is used for launcher system performance testing. In addition, the ASLF has a unique Ocean Simulation Tank and other launch system fixtures that allow the measuring of radiated sound pressure levels. The Three-Inch Launcher Test Facility replicates the full-scale internal countermeasure launcher on SSBN-726, SSN-688, and Virginia class submarines and is capable of performance testing and launch of full-scale devices at various launch depths. The External Countermeasure Launch Test Facility is used for testing improved, six-inch diameter, externally launched countermeasure devices in a variety of simulated platform conditions. The Large Diameter Tube Facility replicates the SSN-21 class submarine torpedo tube. This facility has a loading tray that provides the capability to load/unload full-scale dummy weapons and to test performance of baseline/modified stop bolt mechanisms. The Vertical Launch System facility replicates the SSN-688 class. It consists of a full-scale tube, mechanisms, and tube control panel. Capability is provided to load/unload a dummy Tomahawk missile capsule and to evaluate tube components.

MISSILES ENGINEERING COMPLEX. This complex consists of a number of individual facilities that support missile integration on submarines. The Cruise Missile Laboratory is used to provide factory acceptance testing, quality assurance testing, repair, and unscheduled maintenance for Tomahawk Cruise Missile inert handling shapes, launchable shapes, and support equipment. The facility is also used to prototype and test new equipment and capsule designs and to replicate and resolve fleet reported problems. The Missiles Engineering Laboratory is a multi-function facility used to provide technical and engineering support for submarine-launched missile systems. The facility contains a hardware-in-the-loop capability that can provide a high fidelity dynamic test environment for assessing missile component performance in support of missile or inert vehicle hardware/software development. The Tomahawk Information System (TOMIS) Facility provides a secure, stable environment for the computers and equipment that make up the Tomahawk Information System (TOMIS); including both unclassified and classified systems. The facility houses the central computer complex for TOMIS, used for Tomahawk Cruise Missile inventory data, configuration status accounting data, product assurance data, and logistics support data. The Simulators Development Laboratory is used to support the design, development, test and evaluation of various weapon simulators, including the Digital Missile Simulator Mk 75, the All-Up-Round Electronic Simulator Mk 101, and the Compact All-Up-Round Test Simulator Mk 112. The facility contains special purpose fire control simulation equipment and acceptance testers, as well as general electronic laboratory testers and equipment. Simulator software/hardware integration testing and software debugging are performed in this laboratory.

EQUIPMENT/FACILITIES

COMBAT SYSTEMS EVALUATION & ANALYSIS LABORATORY. The Combat Systems Evaluation and Analysis Laboratory (CSEAL) is a system prototyping environment designed to support the development, integration, evaluation, and demonstration of combat system technology products, advanced development models, and engineering development models. The CSEAL provides for direct input of at-sea test data as an alternative to simulation, and it also provides a mechanism for packing and transfer of prototypes for at-sea evaluation. CSEAL comprises four major components: a comprehensive software development environment, known as the Automated Software for Applications and Prototypes, which facilitates the rapid prototyping and integration of combat system applications; a high-fidelity submarine war-gaming and platform-level simulation based on Navy-approved models; integrated and dynamically-configurable combat system baseline applications and technology products; and analysis and evaluation software for data extradition and approach/event analysis.

SUBMARINE ANTENNA TEST COMPLEX. This complex of four facilities permits full characterization of submarine exterior communications, electronic and imaging warfare systems related antennas/sensors by using unique laboratories and in-the-field test facilities. Stimulation/simulation equipment that replicates advanced radio frequency (RF) emitters, specialized test equipment, and RF anechoic chambers provides highly accurate measurement of systems baseline performance, transmit and receive patterns, and radar cross section signatures. An Overwater Antenna Test Facility in Newport, RI, and a remote, electromagnetically quiet, test sites both on Fishers Island, NY, and an open ocean site 900 feet offshore, are used to measure performance with antennas/sensors operating in the sea water environment simulating actual submarine operations.

ELECTRO-MAGNETIC SENSOR TEST COMPLEX. This complex is a unique combination of 8 facilities that provides full spectrum support for the development, test, evaluation, and in-service engineering for current and future submarine, periscopes and imaging systems. Facilities include the Trident Periscope Facility, Special Mission Electro-Optic Sensor Support Facility, National Periscope Maintenance Facility, EHF Satellite Communication (SATCOM) Development Terminal, Electro-Magnetic System Operational Readiness Test (EMSORT) Development and Support Facility, Six Axis Motion Table, Imagery Archive and Video Editing Facility, and Periscope Engineering RDT&E Facility.

UNDERSEA WARFARE ANALYSIS COMPLEX. This complex has developed and maintains a suite of USW models, databases and U.S. and foreign weapon system hardware-in-the-loop simulations. These are exercised in support of requirements analysis, tactical development, concept development and performance assessment from system level through force and theater levels. This complex comprises two components:

The **Undersea Warfare Analysis Laboratory (USWAL)** component consists of distributed Linux computer servers linked together via a high speed network and tied to a centralized file server. This architecture, combined with an intelligent queuing system provides the USWAL with a specialized simulation environment to support platform and force-level warfare mission assessments. The Weapons Analysis Facility (WAF) simulation component provides a massively parallel processing synthetic environment which integrates a variety of actual weapon hardware and software within its specialized architecture. Thus, real weapons are allowed to perform mission scenarios in the highest fidelity virtual environment the U.S. Navy has developed. The combined computing engines in this complex achieve a maximum throughput exceeding 40 GigaFlops.

EQUIPMENT/FACILITIES

ATLANTIC UNDERSEA TEST & EVALUATION CENTER (AUTEC). AUTEC is a comprehensive open ocean test and evaluation complex located in the ocean waters off Andros Island in the Bahamas. The AUTEC ranges allow testing of aircraft, surface ships, and submarines in an instrumented, calibrated 230-square-mile ocean area with precision tracking in three dimensions of all platforms. AUTEC also provides measurement systems for basic acoustic, environmental, and oceanographic research and test programs. As part of the AUTEC complex, there is a shallow-water OPAREA that consists of a minefield adjacent to a 90 square-mile ocean area with precision tracking in three dimensions of all platforms. The real-time positional information can be displayed on location or linked back to one of AUTEC's display centers at Andros or West Palm Beach. There is also a Portable Tracking System (50 nmi) that can be deployed in OPAREAs of opportunity and provides three dimensional precision tracking of all platforms. AUTEC's facilities are available for use by U.S. and allied foreign government organizations, private industry, and academic institutions.

LITTORAL UNDERSEA WARFARE COMPLEX. The complex is a unique combination of test and tracking facilities and test environments in the Northeast. These facilities and environments represent potential areas of regional conflict (Persian Gulf, Gulf of Oman, coast of Korea) and have been well characterized, contain baseline performance data on existing systems, and can be supported cost effectively by nearby shore activities. The unique Gould Island Elevator/Launch System, deep water piers, and test areas immediately adjacent to NUWC are especially effective for testing systems in shallow water in an effective and affordable manner. Also, the decommissioned diesel submarine USS SALMON provides sonar targets for development of new systems and acts as a training aid for submarines transiting the area aiding in detection and classification of bottom targets.

UNDERSEA RANGES. NATO FORACS AUTEC (NFA) NATO FORACS (Naval FORces Sensor and Weapons Accuracy Check Sites) is a multi-national NATO project with eight member nations: Canada, Denmark, Germany, Greece, Italy, Norway, the United Kingdom, and the United States of America. Its mission is to measure the bearing, range and heading errors of sensors on-board surface ships, submarines, and helicopters. These calibration measurements establish confidence among the member naval forces that target locations can be accurately passed from sensors to weapon systems and other NATO combatant units. The sensors that are tested include: active, passive, dipping and towed array sonars; fire control and search radars; ESM and RDF equipment; infrared, laser and TV sensors; optical sights and peloruses; periscopes, inertial navigation and positioning systems; GPS; and gyrocompasses. There are three NATO FORACS Ranges: Greece, Norway, and AUTEC. NFA is collocated within the AUTEC complex.

SHIPBOARD ELECTRONIC SYSTEMS EVALUATION FACILITY (SESEF). The SESEF program was developed to provide electromagnetic systems test and evaluation services to afloat and shore commands for the development of new and upgraded systems; to validate system performance following new construction and overhaul; and to provide real-time assessment of material readiness in an operational environment.

ACOUSTIC MEASUREMENT CALIBRATION TEST FACILITIES. The Seneca Lake and Dodge Pond acoustic calibration facilities are unique in that they provide full spectrum testing of all types of acoustic devices from small prototypes projectors to full scale arrays and systems. The facilities provide open water test and evaluation capabilities with depths ranging from 50 feet to 500 feet, test ranges to 8000 meters and lifting capacities up to 220 tons. Open year around, the facilities are accessible within

EQUIPMENT/FACILITIES

close proximity of the Northeast industrial area either by highway or in the case of Seneca Lake, access from the Atlantic Ocean is possible through the New York canal system.

UNDERSEA WARFARE EXERCISE COMMUNICATIONS CENTER. The facility provides the ability for real-time and post-exercise monitoring and processing of instrumented underwater range date from the Atlantic Undersea Test and Evaluation Center (AUTEC) and the Atlantic Fleet Weapons Training Facility (AFWTF). This facility is unique in that it enables training, test and evaluation in synthetic environments. UWECC serves as the communications link between simulation and analysis laboratories, T&E and training ranges, and submarines and surface ships. Linkages between ranges, simulators and trainers, government and private laboratories (i.e., geographically separated test facilities) allows for more simulation, less live testing; virtual prototyping; integrated constructive and virtual simulation with live tests; and fully stressed threat environment in training exercises. In the mid-2000 time frame, the Integrated Display Center (IDC) will replace the UWECC.

WEAPONS DEVELOPMENT FACILITY COMPLEX. This complex includes major facilities for design, development, test, and life cycle support of Navy torpedoes, countermeasures, unmanned undersea vehicles, and undersea targets. Torpedo and other vehicle system designs are developed and maintained in the complex. Its Propulsion Test Facility supports electric and thermal (open and closed cycle) propulsion system developments and includes the Deep Depth Propulsion Test Facility, the only land-based facility capable of testing entire torpedoes to maximum power and depth; a total containment High Energy Chamber, designed to contain the total energy content of advanced propulsion systems in an environmentally safe manner; and the Propulsion Noise Test Facility, the only land-based facility capable of measuring radiated noise of operational underwater vehicles on land. The complex also includes the world's quietest anechoic wind tunnel, a 64,000 cubic foot anechoic chamber, the largest Reverberant Acoustic Tank of its kind in the country, the Navy's only large scale sea-water tow tank (3000 feet long) and an advanced materials laboratory, all of which provide comprehensive hydrodynamic, structural and acoustic data on components, as well as on full systems. Development and evaluation of vehicle sonars, guidance and control systems and software are accomplished in the unique Torpedo Life Cycle Support Facility. It includes undersea vehicle testbeds, allowing the capability to integrate new software with vehicle guidance and control hardware and test it under simulated in-water operating conditions.

METROLOGY & MECHANICAL INSPECTION FACILITY. The Metrology & Mechanical Inspection Facility provides 6400 square feet of modern laboratory space dedicated to the calibration and repair of electronic and mechanical test instrumentation used throughout NUWC in support of major combat control, surface ship & submarine sonar, submarine electromagnetic, and weapons systems programs. Functional support areas include: Torpedoes, Launchers, Fire Control Systems, Countermeasures, Submarine Sonar Systems, Surface Ship Sonar Systems, Submarine Combat Systems, Surface Ship Combat Systems, and Submarine Communications and ESM Systems. The facility also functions as a Type II AC/DC and Microwave Calibration Laboratory for calibration and repair of Navy standards used by IMA Depots, and other ship-based, shore-based, and DoD Calibration Laboratories. Within this facility, 1291 different standards are maintained to support calibration of all electronic, mechanical and dimensional test equipment used within the organization. A pool of over 20,000 instruments is maintained for use by the engineers and scientists for shipboard testing and applications within the many technical facilities operated by the Division.

EQUIPMENT/FACILITIES

SURVIVABILITY LAB. The Survivability Laboratory has over 23,000 square feet of specialized laboratory space dedicated to survivability and environmental testing of submarine and surface ship sonar, electromagnetic communications and ESM systems, weapons systems, launcher systems, countermeasure systems, and combat systems. This modern facility supports measurements of the mechanical parameters of sonar equipment and the properties of materials used in underwater mobile and deployed sonar arrays research and development programs. The facility houses large, imbedded pressure vessels specifically designed for testing coiled towed array sonar sensors; large vibration and shock test machines with associated, imbedded seismic masses; and room-size, walk-in temperature and humidity chambers. In addition, there is a full spectrum of dedicated instrumentation and analysis equipment available to support the acoustics array combat system, and weapons testing nature of the facility. The facility is capable of conducting a broad range of tests ranging from individual, specialized experiments for various projects to full Military-Specification environmental qualifications.

INDUSTRIAL SERVICES ENTERPRISE (ISE). The Industrial Services Enterprise provides NUWC with facilities and expertise to perform engineering design, prototype development, advanced manufacturing and part verification/inspection. Emphasis is placed on providing NUWC with Manufacturing Technology support through the application of concurrent engineering and the development of capability in the areas of Computer Aided Design (CAD), Computer Aided Manufacture (CAM), Computer Numerical Control (CNC) of machine processes and advanced material selection/fabrication. At the same time, the ISE provides the manpower, skills, and machinery to fabricate prototype hardware enabling NUWC engineers and scientists to demonstrate, test and verify new concepts under development. The infrastructure for the machines and training of personnel to use those machines, are supported through a Service Cost Center.

INTEGRATED DISPLAY CENTER (IDC). A central display center and adjacent theatre used to support large scale coordinated modeling and simulation activities. Facilities include multimedia front and rear screen projection, audio, television and computer replay. The IDC is linked to other R&D facilities for remote display and control.

Naval Undersea Warfare Center
Newport, RI 02841-1708
(401) 832-6761

Commander: RADM Charles B. Young
Technical Director: Dr. John E. Sirmalis

*FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	1.899	N/A	0.053	1.952
6.1 Other	1.324	N/A	0.552	1.876
6.2	19.766	N/A	7.693	27.459
6.3	14.446	N/A	3.647	18.093
Subtotal (S&T)	**37.435**	N/A	**11.945**	**49.380**
6.4	34.292	N/A	12.936	47.228
6.5	40.843	N/A	28.709	69.552
6.6	42.850	N/A	2.610	45.460
6.7	19.764	N/A	11.474	31.238
Non-DOD	0.000	N/A	0.000	0.000
TOTAL RDT&E	**175.184**	N/A	**67.674**	**242.858**
Procurement	146.154	N/A	142.670	288.824
Operations & Maintenance	62.157	N/A	56.067	118.224
Other	24.951	N/A	19.417	44.368
TOTAL FUNDING	**408.446**	N/A	**285.828**	**694.274**

*MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

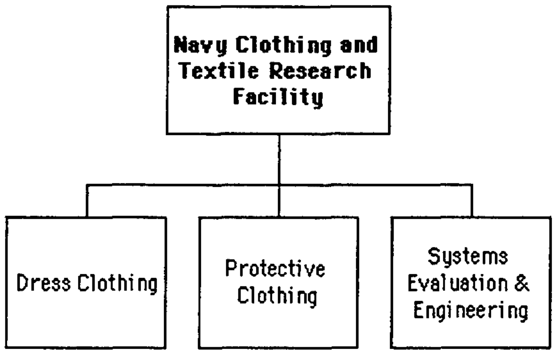
*PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	**SCIENTISTS & ENGINEERS**		**TECHNICAL SUPPORT & OTHER PERSONNEL**	**END STRENGTH**
	DOCTORATES	**OTHER**		
MILITARY	0	0	49	49
CIVILIAN	120	1670	869	2659
TOTAL	**120**	**1670**	**918**	**2708**

*SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1639.000	**REAL PROPERTY**	206.019
ADMIN	287.000	** NEW CAPITAL EQUIPMENT	0.000
OTHER	506.000	**EQUIPMENT**	377.530
TOTAL	**2432.000**	** NEW SCIENTIFIC & ENG. EQUIP.	25.610
ACRES	**719**	** Subset of previous category.	

**As a result of applying the In-House RDT&E Activity criteria at the division level (see NOTE on page 3-1), NUWC Keyport Division data is not included in the FY2000 report.*

Navy Clothing and Textile Research Facility

FY2000 Abbreviated Functional Chart - Technical Organizations



Navy Clothing and Textile Research Facility
Natick, MA 1760
(508) 233-4172
Director: Dr. Barbara Avellini
Administrative Officer: Ms. Marie Dobachesky

MISSION

Conduct research, development, test and evaluation and provide engineering support in clothing, textiles, and related fields associated with service clothing and environmental protective clothing. Our core technologies revolve around individual protection against environmental threats such as, heat, cold, accidental water immersion, fire, steam, biological-chemical exposure, hazardous chemicals, etc. The Natick site, which houses both NCTRF and the U.S. Army Natick Research, Development and Engineering Center has been designated the DoD Center of Excellence for Clothing and Textiles.

CURRENT IMPORTANT PROGRAMS

Joint Protective Aircrew Ensemble (JPACE) - Joint service program to develop next generation chemical-biological protective garments for aircrew of all services. Leading garment design effort as well as assessments of material physical properties, heat stress and flame/thermal protection assessments.

Shipboard Protective Clothing Program - Provide state-of-the-art, commercially available, firefighter's protective clothing, flame resistant utility clothing, anti-exposure suits, cold and wet weather ensembles, and life support systems and equipment for shipboard Navy personnel. Performance requirements and test procedures developed through NCTRF laboratory testing and Fleet evaluation. Testing includes assessment of materials and garments for comformance to industry standards and Navy unique requirements.

AIR WARRIOR - Support of Army program to develop improved integrated aircrew ensemble for rotary wing aircraft. Developing two-piece camouflage flight uniform and supporting overall physical integration of man-mounted equipment and clothing.

DD-21 21st Century Destroyer - Developing First Attack fire suit to allow quick damage control response with reduced manning levels of future ships. Suit to be easily deployed throughout the ship, be donnable in less than 2 minutes and provide sufficient protection to efficiently respond to fires while awaiting full response from Damage Control Team.

Flame/Thermal Test methodology - Developing full-scale system to evaluate ability of various garments to provide protection from a variety of convective, conductive and radiant heat sources, including flame and steam. Includes articulated and non-articulated instrumented manikin development.

Foreign Comparative Test Program - Develop a Personal Temperature Regulation System for the Special Operating Forces. System will consist of a two-piece camouflage garment with an outer shell that is waterproof and breathable and with an attached liner providing temperature regulation and insulating properties. System will provide the warfighter with a garment that allows performance of a variety of tasks at different levels in varying temperature ranges.

CURRENT IMPORTANT PROGRAMS

Technology Transfer - 1) CRADA partnership with Southern Mills to systematically evaluate the insulative qualities of firefighter suits, leading to the establishment of a hierachy of factors for future suit design and development; 2) Patent application filed for an improved integrated hood-mask closure system; 3) Eight testing agreements with industry allow access to NCTRF's unique testing facilities.

EQUIPMENT/FACILITIES

Major equipment and facility capabilities include:

- Two thermal manikin systems used to measure insulation values of protective clothing systems. One system employs heat pipe technology to obtain measurements in an air environment; this manikin is the only known in existence utilizing this technology. The second manikin has the capability to evaluate items in both air and water immersion environments. This is one of only four known manikins worldwide capable of being used in both water and air.
- The environmental test chambers reproduce extremes from 0 degrees Fahrenheit to 130 degrees Fahrenheit at 5% to 95% relative humidity, with winds up to .5 to 15 mph.
- The hydro-environmental simulator with wave-maker is the only known chamber within the Navy that is able to independently control both air and water temperatures simultaneously, and thus simulate any air/water interface.
- A thermal flammability laboratory includes instrumentation to evaluate conductive, radiative, and convective heat.
- A traversing thermocouple instrumented manikin, used to evaluate fire resistant protective clothing at variable heat flux levels and exposure times, when exposed to a propane-fueled fire in an enclosed area.
- A Gerber Micromark/Silhouette computer-aided design system to grade, alter, and trace patterns, and to cut hard patterns.
- A shipboard laundry laboratory.
- Instron testers, weatherometers, fadeometers, launderometer, tear tester, etc., used to determine physical characteristics of clothing and textiles.

Navy Clothing and Textile Research Facility
Natick, MA 1760
(508) 233-4172
Director: Dr. Barbara Avellini
Administrative Officer: Ms. Marie Dobachesky

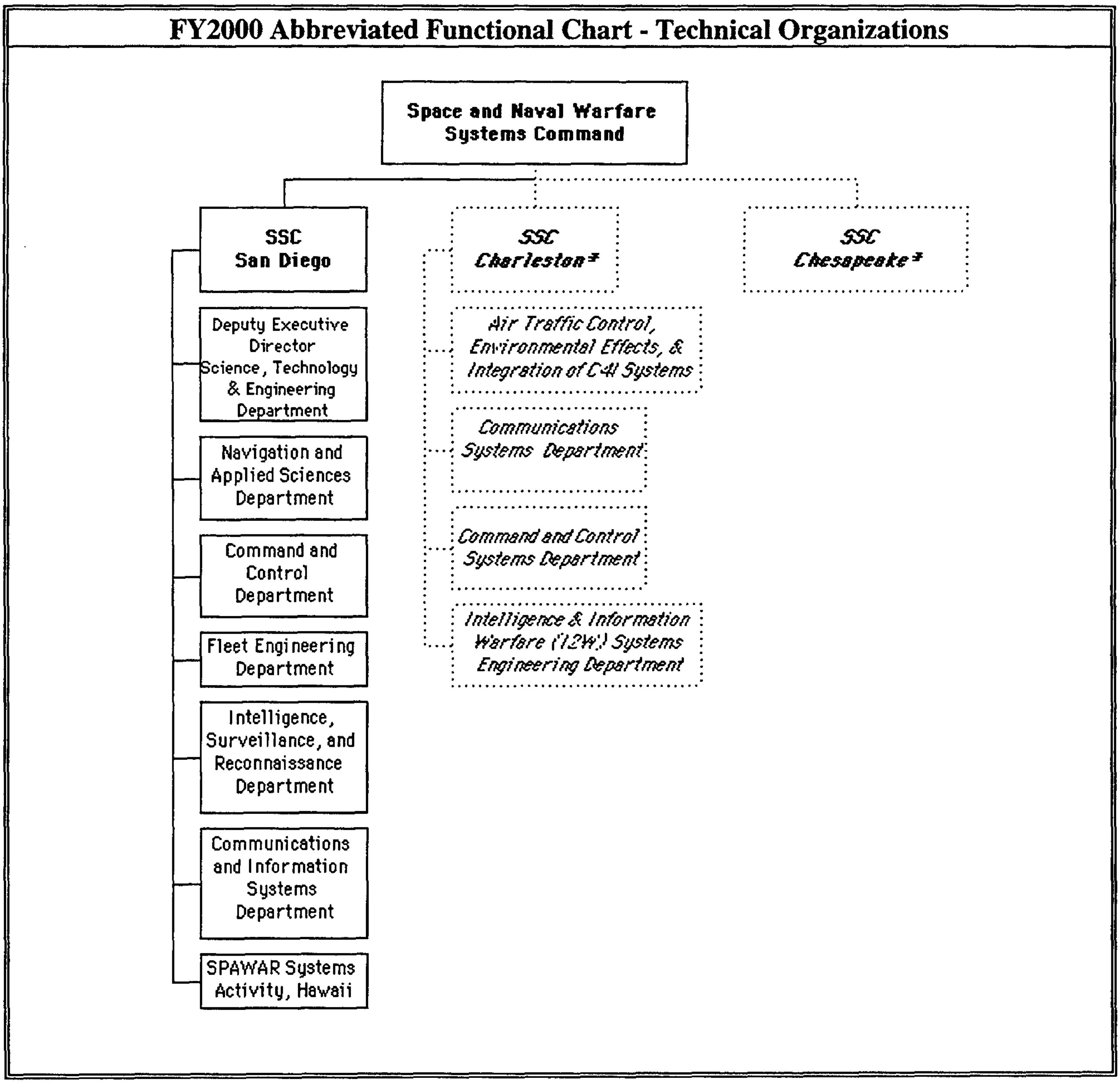
FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	0.000	0.000
6.1 Other	0.000	N/A	0.000	0.000
6.2	0.158	N/A	0.099	0.257
6.3	0.000	N/A	0.000	0.000
Subtotal (S&T)	**0.158**	N/A	**0.099**	**0.257**
6.4	0.351	N/A	0.020	0.371
6.5	0.370	N/A	0.251	0.621
6.6	0.000	N/A	0.000	0.000
6.7	0.000	N/A	0.000	0.000
Non-DOD	0.655	N/A	0.025	0.680
TOTAL RDT&E	**1.534**	N/A	**0.395**	**1.929**
Procurement	0.110	N/A	0.000	0.110
Operations & Maintenance	1.521	N/A	0.319	1.840
Other	0.741	N/A	0.169	0.910
TOTAL FUNDING	**3.906**	N/A	**0.883**	**4.789**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	0	0
CIVILIAN	1	17	10	28
TOTAL	**1**	**17**	**10**	**28**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	12.667	**REAL PROPERTY**	4.373
ADMIN	16.000	* NEW CAPITAL EQUIPMENT	0.073
OTHER	0.000	**EQUIPMENT**	2.805
TOTAL	**28.667**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**0**	* Subset of previous category.	

Space and Naval Warfare Systems Center, San Diego



**As a result of applying the In-House RDT&E Activity criteria at the center level (see NOTE on page 3-1), SSC, Charleston and SSC, Chesapeake data is not included in the FY2000 report.*

Space and Naval Warfare Systems Center, San Diego
San Diego, CA 92152-5101
(619) 553-3000
Commanding Officer: CAPT Ernest L. Valdes, USN
Executive Director: Dr. Robert C. Kolb

MISSION

To be the Navy's full-spectrum research, development, test and evaluation, engineering and fleet support center for command, control and communications systems and ocean surveillance and the integration of those systems which overarch multiplatforms.

CURRENT IMPORTANT PROGRAMS

INTRODUCTION TO SSC SAN DIEGO

Our great strength at SSC San Diego is our unique expertise across the full spectrum of C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance). Our work ranges from basic research and prototype development through systems engineering and integration to life cycle support of fielded systems. Major SSC San Diego programmatic and technical thrusts are directed toward merging advanced technology and systems into integrated C4ISR capabilities; supporting joint C4ISR needs of the military; and cooperating but not competing with industry. While most of SSC San Diego's work addresses Navy needs, we actively support Marine Corps, Air Force, Army, and Coast Guard programs. We also support other government agencies in addressing their unique C4ISR requirements.

SSC San Diego's facilities, laboratories, and fleet communications capabilities allow our engineers and scientists to replicate an operational environment unachievable in the commercial world. Only at SSC San Diego can the pieces of the overall C4ISR system be integrated and tested in both laboratory and operational contexts.

SSC San Diego is uniquely positioned geographically to perform its mission. We are close to major operational commands of the air, surface, and submarine Navy; air, expeditionary, and electronic components of the Marine Corps; the amphibious forces; and the special forces.

Our fleet support extends thousands of miles beyond San Diego Harbor and includes the SPAWAR Systems Activity in Hawaii that supports the Commander in Chief, U.S. Pacific Command, and Commander in Chief, U.S. Pacific Fleet, on-site, and the SPAWAR Systems Facilities in Guam and Japan that support the ships of the Seventh Fleet.

MISSION
To be the Navy's full-spectrum research, development, test and evaluation, engineering and fleet support center for command, control and communications systems and ocean surveillance and the integration of those systems which overarch multiplatforms.

LEADERSHIP AND TECHNOLOGY AREAS
Consistent with our mission, eight leadership areas are formally assigned to SSC San Diego. These leadership areas clearly represent SSC San Diego's C4ISR charter as well as leadership areas outside that scope-ocean engineering and marine mammals. Beyond these, SSC San Diego has demonstrated national- and international-level expertise in a broad range of technology areas.

CURRENT IMPORTANT PROGRAMS

Assigned Leadership Areas
Command, control and communication systems
Command, control and communication system countermeasures
Ocean surveillance systems
Command, control and communication modeling and analysis
Marine mammals
Integration of space communication and surveillance systems

Technology Areas
Ocean and littoral surveillance
Communications and networking
Topside design/antennas
Command systems
Computer technology
Navigation
Intelligence/surveillance/reconnaissance sensors
Atmospheric effects assessment
Marine mammals
Environmental quality technology/assessment
Robotics and physical security

VISION
The overriding goal of C4ISR must be to provide our warfighters the tools necessary to achieve information dominance over all known and potential adversaries. This goal is in concert with the operational precepts outlined in Joint Vision 2010; achieving information superiority is crucial to the full-spectrum dominance sought by our Armed Forces. SSC San Diego's vision--to be the Nation's pre-eminent provider of integrated C4ISR solutions for warrior information dominance--guides our work.

C4ISR

Automated Communications Management System (ACMS). Participate in development of ACMS, a major element of the Milstar Mission Control Segment. ACMS provides all of the capabilities required to satisfy the complex Milstar planning process.

Automated Digital Network System (ADNS). Provide seamless and secure connectivity for voice, video, and data applications afloat and pierside through automated network and radio frequency (RF) resource management.

Extending the Littoral Battlespace (ELB). Partcipate in ELB Advanced Concept Technology Demonstration (ACTD) to evaluate advanced capabilities for Navy and Marine Corps use in littoral warfare. The objective of the ELB ACTD is to demonstrate an enhanced integrated C2/fires and targeting capability to enable rapid employment/maneuver/fire support from the sea of dispersed units operating in a littoral battlespace.

Topside and Antenna Design. Provide topside and antenna design to improve sensor performance, reduce signatures, solve electromagnetic interference problems, and increase affordability. Work

CURRENT IMPORTANT PROGRAMS

includes the design of antennas and mitigation of all electromagnetic interference problems as well as communication technology design, development, and implementation.

Command, Control, and Intelligence Systems. Participate as prime systems engineer, integrator, and software support activity for the Navy's command and control systems fielded on all ships and major shore commands. The Center is currently developing joint command centers for the U.S. Joint Forces, Pacific, Space, and Strategic Commands.

Global Command and Control System-Maritime (GCCS-M). Perform test and evaluation and act as the Software Support Activity for GCCS-M, the designated command and control (C2) migration system for the Navy, representing the evolutionary integration of many previous C2 and intelligence systems.

Link-16. Provide high-capacity, secure tactical data communications in a distributed, networked architecture with a significantly enhanced message structure. Link-16 consists of the Joint Tactical Information Distribution System (JTIDS) data terminal and the Common Data Link-Management System (CDLMS) for shipboard applications, which includes the Command and Control Processor (C2P) and the unique Link-16 antenna set. SSC San Diego has led development of these systems since their inception and continues to develop, test, integrate, and support them on a growing number of new platforms. SSC San Diego also provides world-class life cycle support capabilities in in its role as the Link-16 In-Service Engineering Agent (ISEA).

Multifunction Information Distribution System (MIDS). Participate in the development and testing of MIDS, the new Link-16 data terminal. MIDS is an international development program that will result in a lower cost, smaller, and more readily upgraded Link-16 terminal. SSC San Diego is the lead Navy test activity for MIDS and is actively involved in integration aboard the F/A-18 aircraft and for the MIDS On Ship program.

Data Link Test Tools. Participate in development of Data Link Test Tools, personal computer-based applications that make the connections between ship and shore assets possible. The Data Link Gateway, cornerstone of the Data Link Test Tools, provides a low-cost, logistically feasible way to expand the Link-16 communications horizon between geographically separate test facilities and host combat systems over secure phone lines.

Base Level Information Infrastructure (BLII). SSC San Diego is the program director for BLII and has completed the design, installation, configuration, testing, and acceptance of operational BLII infrastructure at sites in the Pacific Region [Pacific Southwest (PACSW) and Pacific Northwest (PACNW)], Naval Air Station Lemoore, and the Far East (Japan). BLII incorporates the Joint Chiefs of Staff C4I for the Warrior and Information Technology for the 21st Century (IT-21) objectives of providing a seamless, secure, and interoperable global C4I network for the warrior.

Information Operations/Assurance (IOA). Provide IOA capabilities based on a series of Center-developed security engineering processes that include trusted software engineering processes, trusted system engineering processes, vulnerability and risk assessment processes, and certification and accreditation processes. The Center was the first Navy activity assessed as having a trusted software capability maturity [following a model developed by the Software Engineering Institute (SEI) and the National Security Agency (NSA)]. All of these processes have procedures tailored for commercial products as well as for DoD-developed systems.

CURRENT IMPORTANT PROGRAMS

Tactical Cryptologic Systems. Perform systems engineering, software development (integration), and test and evaluation of tactical cryptologic systems to detect, identify, and exploit signals of interest for a variety of missions; provide development and support of several tactical cryptologic systems, including OUTBOARD (Navy shipboard direction finding system) and OUTBOARD Upgrade Programs; Combat Direction Finding; Ship Signal Exploitation System; Battle Group Passive Horizon Extension System (BGPHES) Airborne Receiving System-Surface Terminal; and the Common High-Bandwidth Data Link (CHBDL) System. The Center's Cryptologic Unified Build software provides the basis for most current tactical cryptologic systems.

Cryptologic Unified Build (CUB). Develop CUB software, which provides a common operating system for afloat cryptologic applications. The Center also develops associated CUB databases and the Cryptologic On-Line Training (COLT) system, which provides performance-based training. CUB is currently used as the basis for most tactical cryptologic systems.

Integrated Broadcast Service (IBS). Provide systems engineering for IBS and Joint Tactical Terminal (JTT). IBS integrates multiple intelligence broadcasts (e.g., TRAP Data Dissemination System (TDDS), which was conceived and developed by SSC San Diego) into a system of systems, and migrates tactical receive terminals into a single, related JTT family.

Deployable Autonomous Distributed Systems (DADS). Develop DADS, a system distributed networks of autonomous undersea surveillance sensors. DADS is quickly moving from the conceptual stage into prototype development and testing at sea. The Center played a key role in initiating the development of this new class of sensor through its Autonomous Off-board Surveillance Sensor Science and Technology Capability Initiative.

Integrated Undersea Surveillance System (IUSS). IUSS consists of fixed, mobile, and deployable acoustic arrays that provide vital tactical cueing to antisubmarine warfare forces. The Center has been a leading technical force behind IUSS since its inception, and the Center's role continues to evolve along with IUSS.

Advanced Deployable System (ADS). Provide engineering support for all aspects of ADS. A component of IUSS, ADS is a rapidly deployable undersea surveillance system for littoral water missions.

NAVSTAR Global Positioning System (GPS). Perform research and development for all the Services' GPS receivers. SSC San Diego plays the leadership role for the user segment of GPS and provides software support for Tomahawk GPS receivers.

Navigation Sensor System Interface (NAVSSI). Provide full-spectrum systems engineering design, sensor integration implementation, and engineering support for NAVSSI, a shipboard navigation processor designed to integrate shipboard navigation sensors and systems and distribute a central source of highly accurate real-time navigation and time data to combat, combat support, and communication systems.

GPS Receiver Architecture. Provide principal GPS technical support to the GPS Joint Program Office (JPO) in defining requirements for a variety of GPS receiver acquisitions and initiatives, including

CURRENT IMPORTANT PROGRAMS

GRAM and GVRC, the first GPS "on a card" (Versa Module Eurocard [VME]) and the forerunner of a new generation of GPS Receiver Application Modules to be embedded into navigation systems of the future. SSC San Diego conducted developmental and operational testing essential to the development of GVRC by Trimble Navigation, the major contractor.

Enhanced Position Location Referencing System (EPLRS). EPLRS is an ultra-high-frequency data radio used on the tactical battlefield to provide secure, reliable data in real time. SSC San Diego's work has included integrating GPS into EPLRS, developing downsized EPLRS shelter/vehicle engineering development models, and acting as In-Service Engineering Activity.

Unmanned Aerial Vehicles (UAVs). Exploit UAV capabilities to ensure that the sensor packages and data and the command and control links are fully integrated with Navy tactical systems.

Unmanned Undersea Vehicles (UUVs). SSC San Diego continues to develop technology and systems that support the military requirement for UUVs.

Unmanned Ground Vehicles (UGVs). Provide research and development of the core C4ISR UGV technologies and in the develop autonomous and teleoperated UGV command and control systems.

Mobile Inshore Undersea Warfare-System Upgrade (MIUW-SU). Provide enhanced surveillance and communication capabilities for port security, harbor defense, and coastal warfare missions. The system consists of mobile radar and imaging platforms, underwater acoustic sensors and processing, electronic support measures, and tactical communications equipment. SSC San Diego is the technical design agent, software support activity, and In-Service Engineering Agent.

Human-Systems Technology. Conduct research and development in human-computer interface, automated speech understanding, tactical decision-making, and workload management. The Center was the first Navy organization for human factors technology and is a leader in decision-making under combat conditions. We are also providing human-systems technology support for the development of the Navy's next-generation destroyer and carrier.

Tactical Decision-Making Under Stress (TADMUS). Conduct TADMUS program, to improve human-computer interfaces, both by enhancing computer capabilities to provide information to the warfighter in a more efficient, more comprehensible manner, and by improving the training and behavioral responses of the warfighters to the information provided.

Advanced Human-Computer Interface. Develop an advanced human-computer interface (AHCI) that includes the Open System Advanced Workstation (OSAW) and Display User Enhancement Technology Systems (DUETS).

Meteorology and Oceanography (METOC). Provide a range of capabilities, from system engineering through life cycle support, for Navy and Marine Corps C4ISR METOC Systems. METOC systems integrate data from environmental satellites, shore facilities, and on-site sensors with sensor or weapon system data, platform parameters, and other intelligence to provide the warfighter an accurate, near-real-time assessment capability.

CURRENT IMPORTANT PROGRAMS

Tactical Environmental Support System Next-Century Transition (TESS NC T). TESS NC T provides METOC data and products designed to aid tactical planners. SSC San Diego designed the system change from proprietary architecture to IT-21-compatible non-developmental item/commercial-off-the-shelf platforms, performing all elements from design to initial fielding.

Naval Integrated Tactical Environmental Subsystem (NITES 2000). NITES 2000 is the follow-on effort to TESS. Each NITES system is a set of meteorology and oceanography forecast, database, and decision-aid tools tailored for specific platforms and uses. Five variants support a variety of operators and platforms. SSC San Diego supported integration efforts for Phase I, resulting in successful follow-on test and evaluation of the afloat variant in 1999.

Meteorological Mobile Facility (Replacement) (METMF(R)). Provide ongoing support for METMF(R), which provides a deployable weather office for Marine Corps Expeditionary Operations. SSC San Diego designed, built, and integrated the METMF(R) system.

COMPASS. Demonstrate distributed collaboration for force coordination, mission preview, and mission rehearsal in Joint demonstrations, fleet exercises, and Joint exercises. The Common Operational Modeling, Planning, and Simulation Strategy (COMPASS) brings distributed collaborative planning and modeling and simulation services to a wide range of C4I systems at all command levels, providing interoperability among formerly incompatible systems.

Other Technologies and Research

High Performance Computing and Networking (HPCN). SSC San Diego is a leader in Department of Defense (DoD) HPCN. The Center provides computational scientists with hands-on, interactive access to local systems for algorithm development and high-speed links to remote DoD systems with enormous computing power for research.

Site Characterization and Analysis Penetrometer System (SCAPS). SSC San Diego scientists adapted several optical-based chemical sensing techniques to a probe that provides real-time, nearly continuous, chemical information about underground contaminants. One of our major technology transfer successes, SCAPS technologies are now routinely used nationally and internationally for hazardous waste detection by both government and commercial providers.

QwikLite Bioassay System. Based on the ability of marine phytoplankton to produce bioluminescence, QwikLite bioassays are used as biological tools to gauge the extent of environmental contamination. When time and sensitivity are important, complicated and costly assays using fish or invertebrates may not be suitable. QwikLite can generate risk-based data in 1 day versus 7 to 9 days for more lengthy and complicated bioassays requiring special facilities. QwikLite is also being used as a rapid screening tool for identifying suspect contaminated marine sediment sites (QuikSed Test).

Marine Environmental Survey Capability (MESC). Housed on the 40-foot survey craft RV ECOS, MESC is a real-time data acquisition system designed, built, and maintained by SSC San Diego to provide integrated, rapid, continuous measurement and mapping of oceanographic and environmental parameters in coastal and estuarine environments.

CURRENT IMPORTANT PROGRAMS

Marine Mammal Program. SSC San Diego manages the Navy's Marine Mammal Program, maintaining a cutting-edge research program and managing four operational systems employing marine mammals: Pingered Object Recovery, Swimmer Defense, and two Mine Countermeasures systems.

Waterfront Physical Security (WPS). The Navy's WPS program is an integrated, multi-sensor security system that automatically detects and tracks waterborne (both surface and subsurface) targets, identifies and alerts on all threats, and aids in threat assessment and response. SSC San Diego is the WPS Program Manager and Design Agent as well as In-Service Engineering Agent and Software Support Activity for systems transitioned to the Fleet.

Tigerwall System. Tigerwall is an air surveillance system currently used by the U.S. Secret Service to ensure enhanced physical security at a high-value asset location by providing early warning of airborne threats. SSC San Diego has assisted the Secret Service in implementing and maintaining the Tigerwall system by providing expertise gained from other SSC San Diego surveillance and physical security programs.

Border Research and Technology Center (BRTC). BRTC is a partnership between SSC San Diego and the U.S. Department of Justice's National Institute of Justice (NIJ) that fosters the development of capabilities needed for military operations other than war and law enforcement operations through the sharing and joint development of technology and systems applicable to both.

In-House Laboratory Independent Research (ILIR). New and innovative ideas proposed by the scientists and engineers of SSC San Diego are supported through the In-House Laboratory Independent Research (ILIR) program, administered by the Office of Naval Research (ONR). This program supports basic scientific research in several areas of interest to the Navy, including command and control, communications, surveillance, and navigation.

Fleet Battle Experiments (FBEs). The Navy Warfare Development Command (NWDC) was established to lead Navy FBEs and participate in Maritime Battle Center (MBC) joint experiments. SSC San Diego supports NWDC in developing new concepts to be tested in battle experiments. SSC San Diego is the MBC's planning and execution agent and is responsible for the systems engineering, installation, integration, and testing of all ashore and afloat technologies.

Distributed Engineering Plant. SSC San Diego works with SPAWAR and the Naval Sea Systems Command via a distributed engineering process to ensure that information systems are fully integrated across entire battle groups before deployment.

Integrated BG/ARG Installation. Develop and implement a single management approach that will completely integrate the planning, execution, testing, and training phases for all afloat and shore C4ISR installations. Participate in the installation process for all BGs and ARGs. Additionally, the Center has installation responsibility for all shore-based C4ISR installation work across the Pacific.

EQUIPMENT/FACILITIES

Introduction

SSC San Diego has superb capabilities-physical and virtual facilities and laboratories, distributed test beds, high-performance computers and networks, world-wide communications connectivity-for conducting RDT&E and providing life cycle support in C4ISR. SSC San Diego's unique capabilities allow our scientists and engineers to replicate an operational environment unachievable in the commercial world.

In San Diego, our facilities occupy more than 580 acres. Facilities are concentrated in four major areas: Topside, Bayside, Seaside, and Old Town. Topside facilities, located on the ridge of Point Loma, include the principal administrative and support sections, as well as facilities for communications, environmental testing, electronic materials, advanced electronics, laser technology, and ocean surveillance. Our Bayside facilities face San Diego Bay, which provides waterfront access and berthing capabilities vital to SSC San Diego activities in ocean surveillance, ocean engineering, navigation, and marine sciences. Seaside facilities are located on the west slope of Point Loma, which offers a protected, electromagnetically shielded site essential to RDT&E in C3I and ocean surveillance. The Old Town Campus houses work areas for the fabrication of electronic hardware supporting SSC San Diego's C4ISR programs. The Old Town Campus is also headquarters of the Space and Naval Warfare Systems Command.

Our Hawaii Activity and its two western facilities in Guam and Japan provide electronic systems engineering support to Navy and Marine Corps and Joint Service component forces in the Western Pacific and Indian Oceans.

Our communications connectivity allows most of the Navy's C4ISR systems to be interconnected to support developmental testing as well as to participate in live operations with the U.S. Fleet. SSC San Diego's total capability allows us to provide and manage rapid reconfiguration of our C4ISR capabilities and to provide national and international connectivity using commercial and military capabilities in support of primary mission areas.

List of Capabilities by Major Areas of Effort

C4ISR

Information Operations Center of the Future (IOCOF). A flexible, modular facility that incorporates emerging technologies, development programs, and real-world challenges into a common environment.

Command Center of the Future. A facility to demonstrate, in a realistic context, future C4ISR capabilities. Unique to the Command Center is the 3-D Volumetric Display System, which allows true 3-D visualization of digitized data.

C4ISR Systems Integration Environment (C4ISR SIE). A distributed environment consisting of existing laboratory facilities, systems, and core personnel, the C4ISR SIE supports life cycle acquisition, supports system integration and testing, and assures cost-effective implementation of integrated, joint,

EQUIPMENT/FACILITIES

and interoperable naval C4ISR systems.

High Performance Computing Facilities. Facilities to provide scalable, parallel computing and visualization resources with high bandwidth connectivity throughout the Center and external locations nationwide. Both secure and unclassified environments are available, with end-to-end encryption enabling links to external secure sites.

Advanced Virtual Intelligence, Surveillance, and Reconnaissance (ADVISR) Laboratory. A distributed interactive simulation and future high-level-architecture compatible, physics-based simulator capable of modeling sensors, communications, and command and control systems.

Reconfigurable Land-Based Test Site (RLBTS). A facility to support the development of tactics and procedures for the employment of targeting systems and weapons, concept demonstrations of prototype systems, and the definition of architectures intended to facilitate future acquisition decisions.

Navigation

Global Positioning System (GPS) Central Engineering Activity (CEA). Facility to support acquisition, development, integration, and testing of GPS user equipment and its applications.

Navigation Systems and Ship's Motion Simulator Laboratory. Laboratory housing navigation equipment for developing and testing hardware and software for use in surface, subsurface, and airborne platforms. The laboratory's primary asset is the Ship's Motion Simulator (SMS), which provides a dynamic environment for extensive testing of navigation equipment under realistic conditions before going out to the Fleet.

Fleet Support and In-Service Engineering

Production, Integration and Test Facility. Facility to provide real-time integration of commercial and government off-the-shelf equipment for implementation in the Fleet. This facility also provides engineering and technical services for integration design, rapid prototyping, pre-installation test and checkout, software validation, and environmental qualification.

Environmental Test Facility. Facility to support environmental testing of new fleet equipment. In-house test capabilities include sine and random vibration, various types of mechanical shock, temperature, and humidity. Inclination (pitch and roll) is available, as is deep-ocean pressure testing.

Radiation Indication Detection and Computation (RADIAC) Test Facility. Facility providing calibrated instruments needed for the radiation protection of the Fleet.

Environmental and Biosciences

Ocean Sciences Laboratory. Special facilities for work in marine biology and toxicology, environmental chemistry research, analytical instrumentation development, marine environmental quality assessment and monitoring, environmental biotechnology, radiation sensor development, stochastic resonance, biomedical research, lasers, and microelectronics.

EQUIPMENT/FACILITIES

Bioscience Facility. Facilities for acoustical and physiological research, training, and handling of marine animals to perform naval tasks in the open ocean.

Microelectronics

Integrated Circuit Fabrication Facility (ICFF). A life cycle support environment for critical DoD functions (such as for the Trident Program). Supporting upper radiation-hardened processes, the ICFF provides access to functional circuits (that cannot be obtained from commercial sources) through its computer integrated manufacturing capability.

BLII Integration Laboratory. A state-of-the-art systems integration and testing capability to support all BLII efforts. Efforts include ATM network testing and configuration, proof of concept, and BAN/WAN/LAN simulations/testing. It is also used as a BLII equipment pre-installation, test, and checkout facility.

System Integration Facility (SIF). Laboratory that hosts eight JTIDS and MIDS terminals and can support both live and simulated Link-16 operations. SIF and the Center's Combat Direction System Development and Evaluation Site allow detailed testing of CDLMS, C2P, Link-11, and Link-16 in a true multi-TADIL environment. Link-16 connectivity to other labs both in the U.S. and abroad allows integration testing for a variety of platforms including E2C, F14D, F/A-18, Airborne Early Warning and Control System (AWACS), and Aegis ship platforms.

Space and Naval Warfare Systems Center, San Diego
San Diego, CA 92152-5101
(619) 553-3000
Commanding Officer: CAPT Ernest L. Valdes, USN
Executive Director: Dr. Robert C. Kolb

*FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	2.162	N/A	0.259	2.421
6.1 Other	2.964	N/A	4.144	7.108
6.2	40.950	N/A	196.172	237.122
6.3	27.201	N/A	76.191	103.392
Subtotal (S&T)	**73.277**	N/A	**276.766**	**350.043**
6.4	41.800	N/A	102.596	144.396
6.5	24.989	N/A	37.624	62.613
6.6	3.211	N/A	4.940	8.151
6.7	27.608	N/A	44.963	72.571
Non-DOD	0.000	N/A	0.000	0.000
TOTAL RDT&E	**170.885**	N/A	**466.889**	**637.774**
Procurement	208.327	N/A	179.791	388.118
Operations & Maintenance	109.112	N/A	91.373	200.485
Other	51.738	N/A	37.149	88.887
TOTAL FUNDING	**540.062**	N/A	**775.202**	**1315.264**

*MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

*PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	1	0	71	72
CIVILIAN	186	1601	1659	3446
TOTAL	**187**	**1601**	**1730**	**3518**

*SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1339.000	**REAL PROPERTY**	116.210
ADMIN	992.000	** NEW CAPITAL EQUIPMENT	0.000
OTHER	1976.000	**EQUIPMENT**	234.141
TOTAL	**4307.000**	** NEW SCIENTIFIC & ENG. EQUIP.	6.906
ACRES	**553**	** Subset of previous category.	

**As a result of applying the In-House RDT&E Activity criteria at the center level (see NOTE on page 3-1), SSC, Charleston and SSC, Chesapeake data is not included in the FY2000 report.*

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DEPARTMENT OF THE AIR FORCE

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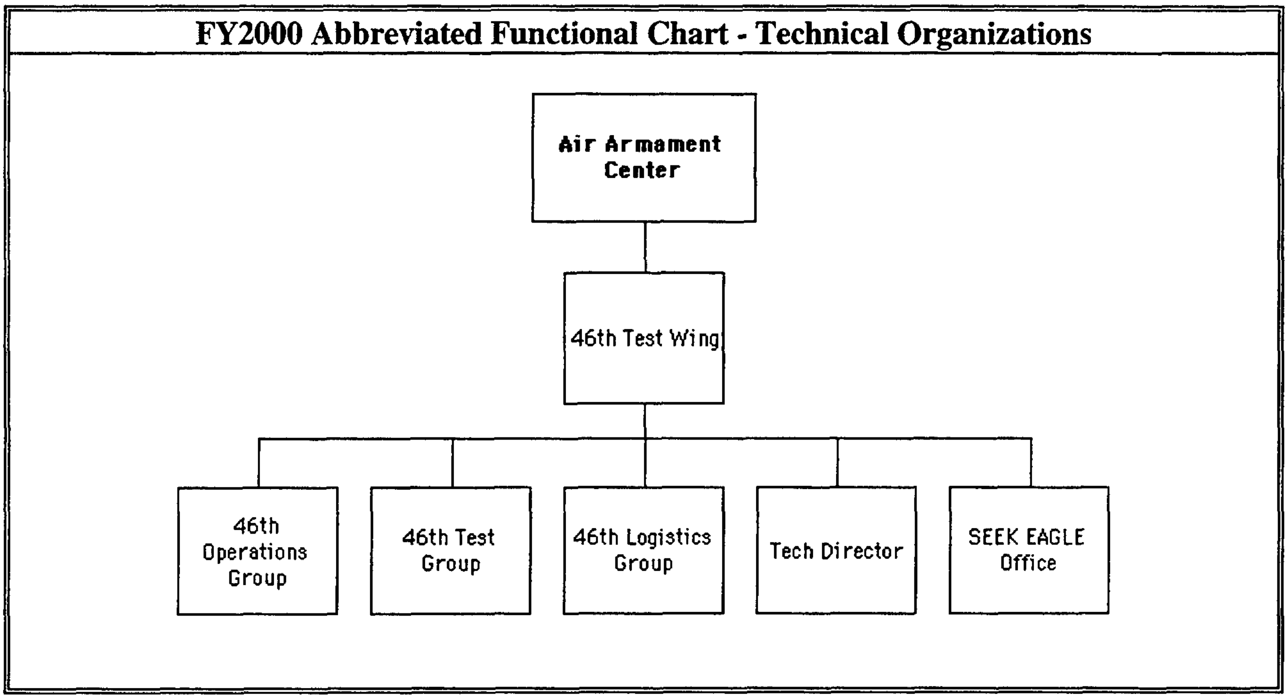
DEPARTMENT OF THE AIR FORCE

The Air Force's fourteen (14) In-House RDT&E Activities are:

NOTE: *The Air Force personnel numbers reflect the total number of personnel assigned at AF organizations with 25% or more of their mission dedicated to RDT&E. These numbers include a significant number of personnel assigned to base operating support activities who are not performing RDT&E workload and who would not be at given locations if not for deployable combat missions. These numbers count personnel, not programmed end strength as reflected in the Future Years Defense Program (FYDP), and should not be used for any comparison or basis of judging the AF RDT&E end strength.*

46th Test Wing



46th Test Wing
Eglin AFB, FL 32542-5001
(850) 882-3931

Commander: Col. Dave J. Eichhorn
Vice Commander: Col. Kevin P. Burns

MISSION

The 46th Test Wing provides:

Responsive and comprehensive test and evaluation services and expertise to support the system and/or component development of air-to-air weapons, guided and unguided air-to-surface weapons, surface-to-surface, and surface-to-air weapons; aircraft guns and ammunition, and aerial targets; electronic warfare (EW) air and ground-based systems; radar, infrared and electro-optical signature determination; intrusion detection; high-speed simulation; command, control, communications, computers, and intelligence (C4I); and climatic simulation; and navigation/guidance systems.

Development Test and Evaluation (DT&E) of non-nuclear air armament for the Air Force to include air/ground launched tactical and air defense missiles, guided weapons, non-nuclear munitions, aircraft guns and ammunition, and aerial targets. Provide DT&E of Electronic Warfare (EW) systems and DT&E of C4I systems.

Support for operational training, Operational Test & Evaluation (OT&E) of armament, EW and C4I systems, and other activities conducted by operational commands.

Test and Evaluation of aerospace navigation and guidance components, systems, and aided systems, simulation of dynamic flight conditions using a supersonic test track, and radar cross-section measurements of full-scale and sub-scale targets, and operational support of multi-service, multi-national test aircraft staging out of Holloman AFB, New Mexico.

CURRENT IMPORTANT PROGRAMS

Advanced Medium Range Air-to-Air Missile* - T&E includes flight test and hardware-in-the-loop testing at the Guided Weapons Evaluation Facility (GWEF) for an improved auto pilot repackaged electronics, new warhead, new fuze, extended rocket motor, shortened control actuator, and improved electronic counter-countermeasures (ECCM). Munitions lethality testing is conducted at Eglin, including Congressionally mandated LIVE FIRE T&E vs. modern threat aircraft.

Hellfire - Production lot and pre-planned product improvement (P3I) testing of Hellfire and Longbow Apache Hellfire Modular Missile Systems.

CHICKEN LITTLE** - A joint Army-Air Force smart weapons test and evaluation organization hosted at Eglin. This organization conducts seeker/sensor and lethal mechanism T&E and system effectiveness evaluations.

Joint Surveillance & Target Attack Radar System (JSTARS) - Tests are conducted on Eglin ranges to evaluate Joint Stars capability to detect and track multiple targets in various environments.

CURRENT IMPORTANT PROGRAMS

Global Hawk-East Coast Deployment - Supported the advanced concept development military utility assessment of the first deployment of the RQ-4A high altitude endurance unmanned aerial vehicle operating location for inter-theater employment.

Theater Battle Management Core System (TBMCS)*** - T&E included in-plant and field developmental testing. Test locations for simultaneous distributed testing include Eglin AFB, Hurlburt AFB, contractor facilities, various Navy facilities and operational ships on either coast, operational units to include 12 AF in Davis Monthan AFB and Langley AFB. Also supported operational T&E prior to fielding decisions. TBMCS is AC2ISRC/CC's number one priority program. It will integrate legacy battle management systems into one multi-service application that is standard for all Air Operation Centers (AOC) and unit-level Wing and Squadron Operation Centers.

Tactical Datalink Link-16 *** - T&E to support Air Force Fighter Data Link tactical data link terminal and software development for F-15E aircraft and Block Cycle Changes for fielded Class 2 terminals in ABCCC, Rivet Joint, JSTARS, AWACS, and MCE platforms. Also supports Navy Aegis test and Army Patriot tests. Link-16 has been chosen by the Air Force as the tactical datalink of choice and will soon be developed, tested and fielded for nearly all operational platforms in USAF inventory.

Base Installation Security Systems (BISS)*** - Conduct DT&E and OT&E in dedicated DoD test facilities and ranges for evaluating exterior and perimeter security subsystems and systems. Systems include base perimeter to protect priority resources such as parked aircraft, weapons storage, and command posts.

SEEK EAGLE - Air Force stores compatibility program hosted at Eglin AFB. Flight tests to verify weapon separation simulations as well as instrumented flight testing (flutter, loads, stability, and control) to define safe carriage and employment limits are conducted on Eglin ranges.

F-15E Tactical Electronic Warfare Systems (TEWS) - Electronic countermeasures performance testing.

Sensor Fuzed Weapon - Production lot flight and P3I ground testing (including DT&E, IOT&E, and LIVE FIRE (LF) T&E) are currently being conducted at Eglin. P3I testing began 2Q FY00 and continues through 2Q FY01.

Joint Direct Attack Munition (JDAM)* - JDAM is a joint Air Force-Navy program. Development, Test and Evaluation planning and flight testing are conducted. Lot Acceptance Testing is being conducted for JDAM Production Lot 3 munitions. A total of thirty-four weapons have been randomly selected from Production Lot 3 munitions. Testing at Eglin AFB will include the release of ten GBU-31 (V)1/B (MK-84) and two GBU-31(V)3B (BLU-109) Guided Test Vehicle in support of JDAM LAT 3 Testing. The twelve weapons will be released from four B-52s from Barksdale AFB.

Joint Stand Off Weapon (JSOW)* - JSOW is a joint Air Force-Navy program. Development, Test and Evaluation planning and flight testing and LFT&E are conducted. Current efforts include the evaluations of JSOW production changes and a low cost control section. Numerous captive carry and several launch missions are planned for FY01.

CURRENT IMPORTANT PROGRAMS

AIM-9X (Air launch, Intercept Mission) - This program is a joint Air Force-Navy program led by the Navy. The 46th Test Wing is the principal Air Force test office. Captive flight testing, separation testing, and live launches continue through FY01.

Advanced Short Range Air-to-Air Missile (British) and Various Allied Weapons - A component of allied munitions testing. The ASRAAM TRIALS (essentially Development, Test and Evaluation) are being conducted by a British Aerospace establishment team at Eglin. These tests are scheduled to finish Aug 01. The ASRAAM Service Evaluation Trial (essentially Operational Testing) begins its one year launch program Apr 01.

Wind Corrected Munition Dispenser (WCMD) - An inertial guided tail kit that replaces the ballistic tail kit on the CBU-87/89/97. When retrofitted with the WCMD tail kit the CBU 87/89/97 become the CBU-103/104/105. INS and GPS information is transferred from the aircraft to the tail kit. The tail kit then guides to dispense point - WCMD allows standard cluster bombs to become smart weapons. Developmental and Operational Test and Evaluation have been completed. WCMD B52 RAA was declared Sep 00 and expected in Oct 00 for the F16 RAA. Performance Integrity Program (PIP) tests are planned to asess contractor Class changes and the affects of aging on weapon performance.

Joint Air-to-Surface Standoff Missile (JASSM)* - JASSM is a joint Navy and Air Force program to acquire a next generation air launch, long range, precision guided standoff missile weapon system. B52-H and F-16C/D Flight Certification Testing and controlled free flights have been conducted during the early stages of the EMD Phase. Captive flight testing, separation testing, and All-Up-Round live launches will be conducted during the next two years as part of a combined DT/OT effort under the management of the newly designated JASSM Combined Test Force. The 46th Test Wing has conducted ground testing to demonstrate hard target penetration capability and determine the hazard classification designation for the JASSM fuze. Additional testing will be conducted during FY00 to further define the penetration capability. Also, analysis and testing were conducted to develop a multi-hit model to be used to predict the use of mulitiple precision strikes against hardened structures.

Conventional Air-Launched Cruise Missile (CALCM) - The Munitions Test Division will support arena and hazard classification testing of the AUP-3(M) warhead in Nov 00. The AUP-3(M) is the penetrator warhead for the CALCM.

Gun and Ammunition Sustainment Testing - A wide range of testing was conducted to evaluate performance of the USAF's inventory of 20mm, 25mm, 30mm, 40mm, and 105mm ammunition and their related gun systems.

Enhanced GBU-15 - During Operation Allied Force, a quick reaction development, test, and production program was initiated to produce an all-weather GBU-15 for the warfighters. The quick reaction program was designated the EGBU-15 Phase 1 program. The production program and the production verification testing was designated EGBU-15 Phase 2 program. The Phase 2 test program was designed to ensure that producibility changes, from the quick reaction program, did not degrade system performance. Phase 2 testing will be completed in Oct 00. Phase 2 includes environmental qualification testing, two captive carry missions, four release missions, and one supersonic separation mission.

PATRIOT - The Alabama Air National Guard (ANG) and Patriot Program Office participated in the second-ever launch of the PATRIOT missile system from Eglin's ranges. Three missiles were launched

CURRENT IMPORTANT PROGRAMS

by the Alabama ANG, the first guard unit to ever employ live PATRIOT missiles. Testing was conducted over the water ranges and will likely become an annual event.

HAMMERHEAD - The Air Force Research Laboratory is the customer in the HAMMERHEAD research and development flight test program. The intent of this program is to couple Global Positioning System (GPS) mid-course guidance with synthetic aperture radar (SAR) terminal guidance on a GBU-15 to provide all-weather precision attack capability. Ground tests were conducted in 1998 followed by captive flight tests in 1999 and 2000. The final flight test is scheduled for November or December 2000. This will be a release test of the HAMMERHEAD weapon at the program building target and will complete the program. The program goal is a 3-meter or better CEP. The final test is planned for 1QFY01.

Bomb Damage Assessment - The result of a Strategic Roundtable Initiative, this program is designed to demonstrate the feasibility of a bomb damage assessment (BDA) sensor. The program intends to show the usefulness of a deployable video system to expedite BDA, thereby enhancing the war fighter's operational effectiveness. Flight testing during FY99 revealed several design deficiencies. Contractor resolved design issue and conducted a successful flight test in May 00. Customer has requested to conduct three additional flight tests during 2-3QFY01. The most recent flight test (May 99) revealed several design deficiencies, all of which are currently being addressed by the contractor and will be resolved prior to future-flight testing. Target date to resume testing is Mar 00. Plans include at least 1 more live GBU-10 drop with BDA camera installed.

AGM-130 Midcourse Guidance (MCG) - The MCG test program was conducted in response to an Air Combat Command (ACC) requirement for the improvement of the existing AGM-130A weapon system. The test program was conducted in two phases. Phase one added an inertial navigation system (INS) that is position and velocity aided by the Global Positioning System (GPS). The purpose of the INS/GPS is to reduce the Weapon System Officer workload by navigating the weapon to the target. Phase two added the Horizontal Target attack requirement to deliver the BLU-109 warhead against hardened horizontal targets. All testing of this test program has been completed and the weapon system was used during Operation Allied Force.

Powered Low Cost Autonomous Attack System (LOCASS) - Testing of the powered LOCAAS is planned to be conducted over Eglin land ranges starting in Mar 01. The test is designed to evaluate the systems ability to acquire, classify, and attack ground targets.

Air Force Mission Support System (AFMSS) - Testing of the core software and many of the 50 plus aircraft/weapon/electronic system software modules for mission planning.

Mission Systems - Combined DT/OT testing of the Air Force Mission Support System (AFMSS) software including the Mission Planning System (MPS) and the Portable Flight Planning (PFPS) was conducted on Eglin. Planning for the Joint Mission Planning System (JMPS) was continued with testing of JMPS Beta 1 and Beta 2 accomplished.

TRIDENT - An instrumented pod developed to evaluate missile guidance software updates. The pod is flown on the F-15E aircraft.

CURRENT IMPORTANT PROGRAMS

BOL Chaff and Flare Dispenser - This foreign comparative test evaluated the operations of this new dispenser on the F-15E.

The following are Business Development focus areas providing the unique partnerships or cooperative opportunities:

Air Armament Summit - The AAC Summit process is a unique opportunity to bring together elements of government, industry, and academia to assess current weapon initiatives and look for weapon development, employment, and sustainment future states. This allows all stakeholders in the future of air armament to come together and plan for the future. The 46th Test Wing is a key participant in the summit process. See Air Armament Summit on the Eglin home page. Summit III is scheduled for Mar 2001.

Partnership Intermediaries - The 46th Test Wing uses Partnership Intermediaries, such as the Gulf Coast Alliance for Technology Transfer (GCATT) and the Southern Technology Applications Center, to facilitate the transfer of technologies for commercialization and the use of AAC test facilities for Commercial Test Agreements. The GCATT has facilitated a Cooperative Research and Development Agreement with the Aeroballistic Research Facility at Eglin to provide customers in a research environment for collaborative testing projects. In this agreement, GCATT provides customers, operation, maintenance, and marketing for the facility.

T&E Partnering - The 46th Test Wing uses unique agreements with industry partners to sustain infrastructure capabilities necessary for the T&E of weapon systems. For example, a T&E partnership facilitated the National Radar Cross Section Test Facility partnership, which allowed Boeing, Inc. to move some infrastructure to Holloman AFB to maintain a national RCS capability.

Licensing - AAC assesses its patent portfolio for licensing opportunities to facilitate commercialization of government held intellectual property. Both the inventor and 46th Test Wing labs or test facilities share in any royalties. See opportunities on the Eglin AFB Home page.

Product Demonstrations - AAC (to include the 46th Test Wing) actively pursues joint development and demonstrations of new weapon concepts to provide new or improved combat capability in short term (12-18 months) in support of the warfighter. For example the Hellfire/UAV demonstration that is now ongoing, is being facilitated by a product demonstration partnership.

At Holloman AFB are the:

NASA X-34 (Spaceplane) - The 586 TS provides ground and flight support for the test of NASA's X-34 reusable launch vehicle and technology demonstrator.

Miniaturized Airborne GPS Receiver 2000 (MAGR 2000) - The objective of the MAGR-2000 acquisition is to continue to support and sustain DoD Project 2000 through the fielding of qualified, warranted, Form, Fit, and Function (F3) MAGR-equivalent receivers. The plan is to acquire, validate, and verify by Production Representative Testing that the MAGR 2000 Receiver preserves, and/or improves upon the performance, operability, supportability, and maintainability of the current MAGR.

CURRENT IMPORTANT PROGRAMS

Miniaturized Airborne GPS Receiver Upgrade (MAGRU/EGIU) - is an Advanced Concept Technology Demonstration (ACTD) program which will demonstrate the GRAM (GPS Applications Receiver Module) and D-Y (Direct Y code tracking) while maintaining backwards compatibility to a MAGR/EGI. Integration for flight will occur on the F-117A, AV-8B, and F-18.

Perimeter Protection - The Perimeter Protection system utilizes pseudolite attributes and satellite navigation technology to mitigate hostile use of satellite navigation by unfriendly forces while ensuring unimpeded use of the GPS for U.S. and allied forces.

Selective Availability Anti-Spoofing Module (SAASM) - The SAASM will be the next generation Precise Positioning Service (PPS) security device. The SAASM will be a single, tamper-resistant, multi-chip module that incorporates all GPS selective availability, anti-spoofing, cryptographic, and encrypted electronic keying functions for PPS host application equipment.

Joint GPS Combat Effectiveness (JGPSCE) - was chartered by the office of the Secretary of Defense (OSD) in July 1999. The objectives are to quantitatively and qualitatively assess the impacts of the loss of GPS on joint operations. The JGPSCE Joint Test Force (JTF) will employ multi-service and other Department of Defense (DoD) agency support, personnel, and equipment to conduct tests. The focus area of this JT&E is on precision engagement as an element of Joint Vision 2010 with test venues structured around joint reconnaissance and interdiction mission areas.

Navigation Warfare (NAVWAR) - The Navigation Warfare (NAVWAR) Program will mitigate threats by improving the performance of US and allied military class GPS PPS receivers in the operational threat environment. The 746 is testing assets includes Airborne Jammers, HMMWV-mounted ground jamming assets, and small man portable jammers.

PAC-3 Blast and Impact Lethality Testing - The Patriot Advanced Capability 3 (PAC-3) Live Fire Test & Evaluation (LFT&E) program tests full-length and reduced-length full scale interceptors against targets at defined engagement conditions.

SM-2 Warhead LFT&E - The 846 TS is testing the Block IV-A upgrade to the US Navy's current anti-missile defense system, the SM-2 missile. This LFT&E program will provide lethality data on the shrapnel-producing warhead mode of this upgrade.

Suite of Integrated Infrared Counter Measures/Common Missile Warning System (SIIRCM/CMWS) - is the next generation infrared (IR) countermeasures designed to protect aircraft against heat-seeking missiles. The test objective is to study SIIRCM/CMWS threat prioritization and to measure the radiation incident on the nose cone of the missile as it approaches the SIIRCM-equipped helicopter.

Egress and Recovery Systems - The 846 TS operates sled test programs including performance testing of the F-22A's ejection seat and life support system; Test and Evaluation of ACES II escape system; and ejection seat testing of joint USAF/USN efforts to increase the reliability and maintainability of aircraft escape systems.

*Navy and Air Force Joint Programs
**Army and Air Force Joint Programs
*** Multi-service programs, Army, Navy, and Air Force

EQUIPMENT/FACILITIES

Capabilities and facilities include those for armament and C4I (Command, Control, Communication, Computer System, Intelligence) testing. The only DoD location with contiguous major land (724 sq. mi.) and water test ranges (125,000 sq. mi.), and the largest climatic test facility in the free world. Equipment and facilities include: a DoD High Performance Computing Center (real-time and post mission support); airborne and ground based multispectral signature measurement; Seeker Test and Evaluation Facility (STEF); kinetic energy munitions test facility (sled track); static warhead arenas; gun test facilities; combined hardware and simulations testing (Guided Weapons Evaluation Facility - GWEF) and Preflight Integration of Munitions and Electronic Systems (PRIMES) facility; time-space-position information; telemetry systems facilities including airborne relay; airborne and surface targets; ground threat systems; base installation and security systems (BISS) test facility; photographic laboratory; Wing Operations Center and Squadron Operations Center test facility; Link-16 Support Facility; and aircraft maintenance (test associated) facilities.

Also, at Holloman AFB are:

High Speed Test Track (HSTT): The world's longest sled track (50,788 ft), the Project Reliance lead for all DoD test tracks, and the Center of Excellence for ejection seat testing. The HSTT supports sled speeds exceeding Mach 8 and accelerations up to 200G for aerodynamic tests, impact tests, and missile simulations in various controlled environments of rain, particle, and blast/shock wave.

Central Inertial Guidance Test Facility (CIGTF): The DoD Center of Expertise for the test and evaluation of Inertial Navigation Systems (INS), GPS, and blended GPS/INS components and systems in both benign and electronic warfare environments.

National Radar Cross Section (RCS) Test Facility (NRTF): NRTF is a one-of-a kind facility combining the best of monostatic and bistatic radar cross-section (RCS) measurements. The NRTF has computer resources to support Radar Cross Section (RCS) target predictions, detection profiles, model validation, and real-time diagnostic imaging.

586th Flight Test Squadron: Aircraft support for testing of air-to-air missiles, air-to-ground ordnance, photo/safety chase, inertial navigational systems, and Global Positioning Systems. The squadron operates two T-38's and a C-12, and uses F-15 and F-16 aircraft from Eglin AFB.

46th Test Wing
Eglin AFB, FL 32542-5001
(850) 882-3931

Commander: Col. Dave J. Eichhorn
Vice Commander: Col. Kevin P. Burns

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	2.774	0.047	6.165	8.986
6.2	3.375	0.057	7.499	10.931
6.3	2.303	0.039	5.118	7.460
Subtotal (S&T)	**8.452**	**0.143**	**18.782**	**27.377**
6.4	2.181	0.037	4.847	7.065
6.5	17.671	0.296	39.269	57.236
6.6	193.048	1.174	122.289	316.511
6.7	21.859	0.367	48.576	70.802
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**243.211**	**2.017**	**233.763**	**478.991**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	22.040	N/A	87.561	109.601
Other	0.000	N/A	0.000	0.000
TOTAL FUNDING	**265.251**	**2.017**	**321.324**	**588.592**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	6.070

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	END STRENGTH
	DOCTORATES	OTHER		
MILITARY	2	82	4005	4089
CIVILIAN	16	660	2128	2804
TOTAL	**18**	**742**	**6133**	**6893**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	0.000	**REAL PROPERTY**	292.890
ADMIN	93.438	* NEW CAPITAL EQUIPMENT	0.000
OTHER	1612.145	**EQUIPMENT**	530.900
TOTAL	**1705.583**	* NEW SCIENTIFIC & ENG. EQUIP.	20.500
ACRES	**463546**	* Subset of previous category.	

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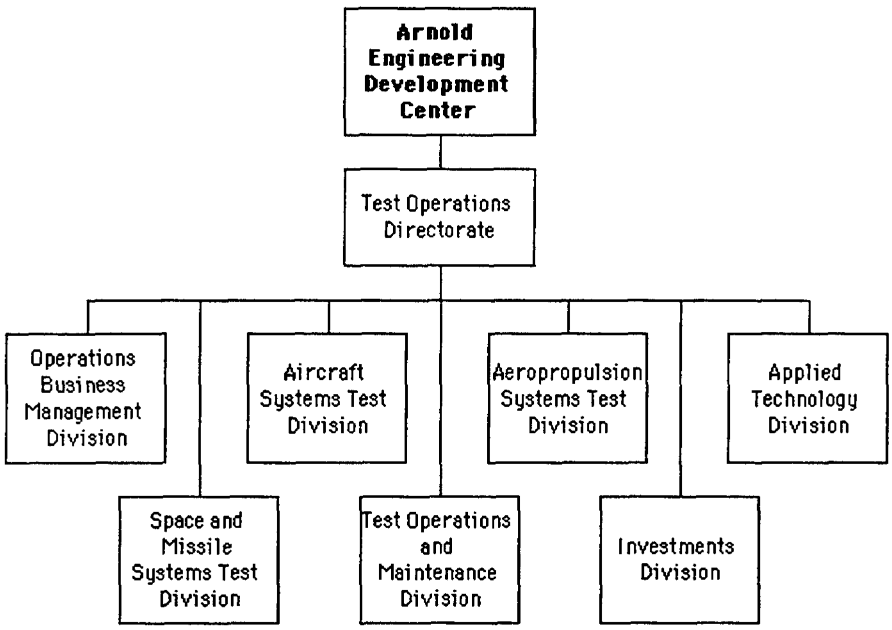
Arnold Engineering Development Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Arnold Engineering Development Center
Arnold AFB, TN 37389-1303
(615) 454-5201

Commander: Col Michael L. Heil, USAF
Executive Director: Mr. Alan B. Goldstayn

MISSION

AEDC is a national aerospace ground test facility that conducts tests, engineering analyses, and technical evaluations for research, system development, and operational programs of the Air Force and Department of Defense, other government agencies, and industry. Using ground test facilities, AEDC supports propulsion, aerodynamic, re-entry, transatmospheric, and space-flight systems testing. Testing is performed in an environment that simulates operational conditions. AEDC performs research to develop new technology for advanced test facilities, test techniques, and measurement methodologies associated with ground testing.

CURRENT IMPORTANT PROGRAMS

The following list contains some of the more important test programs at the Arnold Engineering Development Center:

F-22 Fighter: Wind tunnel testing and analysis accomplished supporting the engineering/manufacturing/development phase; majority focused on store separation testing.

F119 Engine for F-22: Significant altitude development testing completed for flight envelop expansion for the flight test program. Also accomplished altitude qualification and RAM Accelerated Mission Test qualification of Flight Test Engine #18 in support of the Defense Acquisition Board decision criteria for the Initial Service Release milestone and engine flight clearance.

Support to F-22 Flight Test: AEDC provided significant support to the F-22 CTF at Edwards AFB through analysis/prediction of AIM-9M launch trajectories, calculation of fields of view for camera locations, reduction of propulsion test re-fly rate by using the AEDC-developed data validation tools, and analysis of bay door structural loads caused by missile exhaust.

F-18 Fighter: Store separation and loads testing conducted on the E/F versions of the aircraft.

Joint Strike Fighter (JSF): Significant variety of wind tunnel testing accomplished for both competing contractors.

B-1B Bomber: Store separation testing conducted to integrate JASSM.

UCAV: Store separation testing accomplished during concept exploration to evaluate weapons platform effectiveness.

F119 Engine for JSF: AEDC completed the necessary propulsion testing for the JSF Concept Demonstration Assessment (CDA) Phase of the JSF Program. Over 200 hours of testing on the two F119 engine variants have been completed this fiscal year. Among the many objectives, testing verified

CURRENT IMPORTANT PROGRAMS

proper operation of the engine controls and determined effects of inlet temperature distortion on engine stability. The engines were cleared for flight for all subsequent flight test activity in the CDA program. Planning has begun for follow-on development testing of either configuration after weapon system source selection.

JDAM: Testing in support of time critical weapon modifications.

F100 Engine for F-15/F-16: Three F100-PW-229 and one F100-PW-220 engines were tested at AEDC for the Component Improvement Program. The tests accomplished many tasks including validating increased surge margin with modified compressor stators on the -229 engine and increased durability of stiffer compressor blades on the -220 engine.

F101 Engine for B-1: New digital engine controls for the F101 engine were certified for flight at AEDC. These new controls will replace the aging and difficult to maintain analog controllers currently in FY01.

Joint Expendable Turbine Engine Concept (JETEC) II Engine Test: Completed testing on the XLT-86/1 and XLT-86/2 technology demonstrator engines. They incorporated low cost, low part count, compact and light weight components. These tests verified the new designs meet the Integrated High Performance Turbine Engine Technology (IHPTET) phase II performance goals.

Loral GOES Satellite: Involved checking the satellite out in a vacuum with the actual operation simulated over the range of thermal conditions the satellite is expected to experience.

Electro-Propulsion: Lockheed Martin Hall Effect Thruster will be characterized for plume effects on integrated satellite operation. The 12V Chamber is being configured to test a variety of Electro-propulsion technologies.

Evolved Expendable Launch Vehicles: Provided simulated altitude test services for the RL-10B-2 upperstage engine to be used on the Boeing Delta III and Delta IV launch vehicles.

Peacekeeper Intercontinental Ballistic Missile (ICBM): Provided simulated altitude test services for both aging and surveillance of one Stage II solid rocket motor.

Minuteman III ICBM: Provided simulated altitude test services for aging surveillance of one Stage II solid rocket motor.

Minuteman III Propulsion Replacement Program: Provided simulated altitude test services for development of the replacement second and third stage solid rocket motors.

Ground Base Interceptor: Calibrated and tested the sensor using target simulation packages traceable to national standards. Evaluated in a vacuum, cryogenic environment that closely simulated actual operation conditions.

Theater High Altitude Area Defense (THAAD) Program: Performed testing to study how bulk chemical and biological stimulants will dissipate in the atmosphere after the threat bulk chemical target is impacted by the THAAD interceptor.

CURRENT IMPORTANT PROGRAMS

National Missile Defense (NMD): Performed sub-scale hypervelocity impact testing to evaluate the lethality of the NMD Exoatmospheric Kill Vehicle (EKV) against nuclear threat targets.

USAF Peacekeeper RV Testing: AEDC completed multi-run test entries characterizing the performance of several candidate heatshield variants for the Peacekeeper re-entry vehicles. The testing was sponsored by the USAF RVAP Program.

NASA Hyper-X: A number of leading edge material candidates were tested in simulated hypersonic conditions with the test data being used to make a material down-select.

NASA/Boeing X-37 Program: Obtained static stability data for the NASA X-37 configuration at high Mach number (M-14) and high-angle-of-attack conditions in Tunnel 9. Tests supported critical design review decisions.

Siemens Westinghouse: Supports ground power turbine combustor development. Utilizes core engine test capabilities off-setting government costs.

EQUIPMENT/FACILITIES

AEDC represents a $6 billion investment in the most advanced and largest complex of flight simulation facilities in the world with test units having capabilities unmatched elsewhere. AEDC encompasses three main business areas: Aeropropulsion, Aerodynamics, and Space and Missiles.

The Aeropropulsion Business Area includes 15 turbine engine test cells supporting aircraft and missile system research and development simulating flight tests over a wide range of Mach numbers and altitudes to determine operational characteristics of air breathing propulsion systems. Test capabilities include engine performance and operability, engine/inlet integration, and environmental/climatic testing. Unique military requirements supported include afterburner use, high altitude flight, high speed low altitude flight, maneuverability, fighter/bomber engine/inlet integration, and environmental testing.

The Aerodynamics Business Area includes 7 wind tunnels (conventional, continuous-flow, and intermittent blowdown) supporting flight simulation, store separation simulations, computational fluid dynamics, and engineering approximations of relatively large-scale models of high speed aircraft, missiles, and spacecraft. Unique military requirements supported include high performance fighter flight simulations, full-scale engine/inlet/exhaust testing, and store separation simulations.

The Space and Missile Business Area includes altitude rocket facilities, propulsion research test cells, aerospace chambers, hypervelocity wind tunnel, continuous flow arc-heated facilities, and free-flight ranges providing test capabilities for rockets, spacecraft, and hypersonic interceptors and re-entry systems. Unique military requirements supported include large solid and liquid rocket altitude tests, aero/thermal testing, high speed impact/counter fire, high speed large model launches, soft model recovery, digitally controlled scene generation, and multi-functional focal plane array.

Arnold Engineering Development Center
Arnold AFB, TN 37389-1303
(615) 454-5201

Commander: Col Michael L. Heil, USAF
Executive Director: Mr. Alan B. Goldstayn

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.880	N/A	N/A	0.880
6.1 Other	0.000	0.000	0.000	0.000
6.2	1.075	0.002	0.040	1.117
6.3	1.083	0.002	0.040	1.125
Subtotal (S&T)	**3.038**	**0.004**	**0.080**	**3.122**
6.4	32.618	0.060	1.200	33.878
6.5	24.775	0.046	0.911	25.732
6.6	131.180	0.750	14.994	146.924
6.7	30.292	0.056	1.114	31.462
Non-DOD	22.583	0.001	0.829	23.413
TOTAL RDT&E	**244.486**	**0.917**	**19.128**	**264.531**
Procurement	0.439	N/A	0.016	0.455
Operations & Maintenance	36.015	N/A	10.833	46.848
Other	8.763	N/A	0.439	9.202
TOTAL FUNDING	**289.703**	**0.917**	**30.416**	**321.036**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	1	9	88	98
CIVILIAN	2	71	121	194
TOTAL	**3**	**80**	**209**	**292**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	225.049	**REAL PROPERTY**	1410.597
ADMIN	504.151	* NEW CAPITAL EQUIPMENT	0.000
OTHER	2131.260	**EQUIPMENT**	236.449
TOTAL	**2860.460**	* NEW SCIENTIFIC & ENG. EQUIP.	0.455
ACRES	**39081**	* Subset of previous category.	

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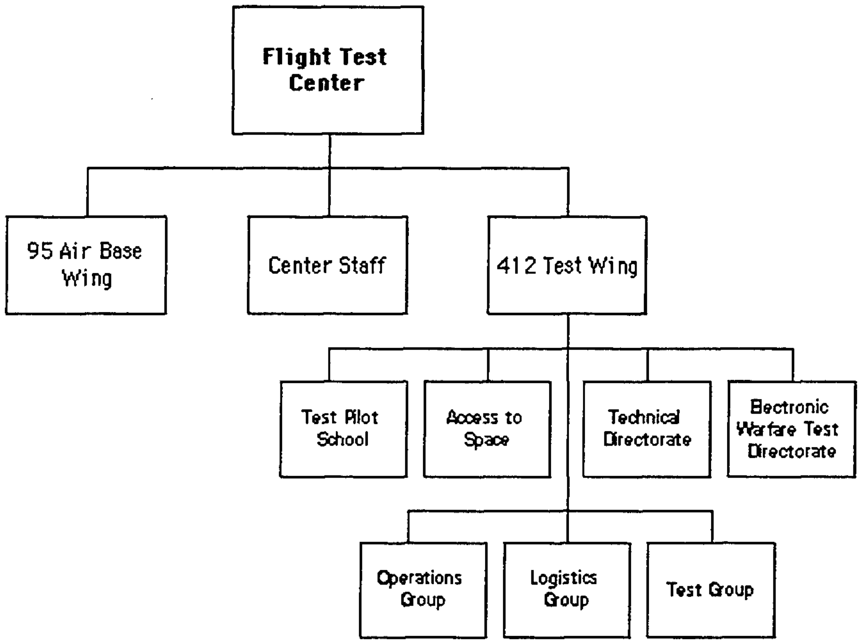
Flight Test Center

FY2000 Abbreviated Functional Chart - Technical Organizations



Flight Test Center
Edwards AFB, CA 93524-1033
(805) 277-3229

Commander: Maj Gen Richard Reynolds
Executive Director: Mr. Les Bordelon

MISSION

Air Force Flight Test Center's (AFFTC) job is to support the warfighter through test and evaluation. The Air Force Flight Test Center provides the premier aerospace research, development, test and evaluation and support for the United States and our allies. The Air Force Flight Test Center also supports non-military government agencies, commercial and allied nations test and evaluation needs. The capabilities of most of the Air Force's weapons systems were first proven at Edwards, giving the Air Force Flight Test Center a direct, tangible link to the Air Force's core competencies (air and space superiority, global attack, rapid global mobility, precision engagement, information superiority, agile combat support, and command and control). The long-term end state of the AFFTC is a multi-mission military/industrial base with operational runways, assigned flying mission activities, major air, land and/or sea ranges, and unique national military capabilities. The future is expected to lead to more unmanned aerospace systems, support for commercial test activities, air and space operations, tenant and base community support activities. Support services will be extensively augmented by contract assistance and alliances with other government and commercial entities.

CURRENT IMPORTANT PROGRAMS

B-1 BOMBER AVIONICS AND CONVENTIONAL WEAPONS UPGRADES

The B-1B is a flexible bomber with a large payload capability and long range that makes it an ideal aircraft to support our deterrent posture across the full spectrum of conflict. The B-1B has been designated to form the core of future conventional bomber capability. The challenge of a conventional role requires the development of an extensive offensive and defensive capability without compromising current capability. The conventional mission upgrade program (CMUP) is planned to accomplish the changes required for the B-1B aircraft to become an effective conventional bomber. The CMUP program adds new computers, re-hosted software, increased weapons flexibility, and a new defensive suite. These changes are designed to increase maintainability, increase mission effectiveness, and reduce maintenance costs associated with the defensive systems.

B-2 BOMBER FOLLOW-ON PROGRAM

The B-2 Follow-on Flight Test Program is a Development Test and Evaluation program. The follow-on program continues to enhance mission effectiveness by correcting deficiencies and adding new capabilities to the fielded aircraft. Enhancements continue to be made and evaluated in low observable maintenance, composite structure, flight control system, air data system, software integration, and the defensive system.

B-52 BOMBER UPGRADES

The B-52H is an all-weather Interdiction Bomber capable of launching conventional weapons (CALCM, Mk-82, Mk-62, Mk-84, CBU-87, CBU-89,CBU-97, M-117, AGM-142, JDAM, GBU-10, GBU-12, Sea

CURRENT IMPORTANT PROGRAMS

Mines, WCMD) and nuclear weapons (B-61, B-83, ACM, ALCM). Upcoming upgrades are planned in the following areas: advanced weapons integration, advanced avionics integration, situational awareness and survivability. Advanced weapons integration will include the: Joint Stand-Off Weapons (JSOW), Joint Air-to-Surface Stand-Off Missile (JASSM) and 500 lb Joint Direct Attack Munitions (JDAM). advanced avionics integration consists of the Avionics Midlife Improvement Program (AMI). AMI replaces the Inertial Navigation System (INS), Avionics Computer Unit (ACU), and Data Transfer System (DTS) to avert loss of combat capability beginning in FY06. Situational awareness and survivability upgrades consists of Electronic Counter Measures Improvement (ECMI) and Situational Awareness Defensive Improvement (SADI). ECMI installs a new Control Display Unit (CDU) and 1553 data bus to provide enhanced intra-system communication. ECMI will provide the ability to respond to changes to the threat and maintain situation awareness (SA). SADI replaces the unsupportable AN/ALR-20 panoramic receiver. SADI will keep current system from becoming unsupportable and will prevent the lost of primary means of SA. SADI will restore early warning and combat SA.

C-17 TRANSPORT FOLLOW-ON PROGRAM

The C-17 Follow-On Flight Test Program is a Development Test and Evaluation program. This program will support the fielded system which results from the C-17 Weapon System Production, Field Support or Flexible Sustainment contract and support enhancements to C-17 capabilities by supporting the authorized Producibility Enhancement/Performance Improvement Program. The program encompasses, but is not limited to, testing needed for engineering studies, preplanned product improvements, performance improvements, system upgrades, modifications of production equipment, field problem evaluations, production cut-ins, and mission changes. The program is providing data for use in design studies, system development, field problem resolution specification compliance and performance characteristic evaluations.

C-130J TRANSPORT

The C-130J Test and Evaluation program is currently planning for the next block of flight testing at Edwards AFB on a USAF-owned aircraft. The FY00 tests of Block 5.2 supported the recommendation to move to operational testing for Airland capabilities of the basic Lockheed C-130J aircraft and unique USAF C-130J systems. The tests have included the following: software regression testing, avionics, personnel airdrop (paradrop), wake vortex, defensive systems. Another facet of C-130J testing was the WC-130J "Hurricane Hunter" test accomplished out of Keesler AFB, MS to qualify the WC-130J for hurricane-penetration weather reconnaissance missions. The WC-130J was flown by AFFTC crews using test plans prepared by AFFTC engineers into hurricanes (including Hurricane Lenny - a CAT V storm with sustained winds over 150 mph) in order to evaluate the new aircraft for the hurricane hunter mission, subsequent AFFTC conducted QT&E is scheduled to evaluate deficiency resolutions. The WC-130J was recommended ready for Force Development Evaluation in January 2000.

CV-22

The Air Force variant of the V-22 Osprey is a Vertical/Short Take Off and Landing (VISTOL), tilt rotor aircraft. The baseline aircraft is fully fly-by-wire with triple redundant digital fight control computers. The flight control computers are integrated with the mission computer and the vibration, structural life and engine diagnostics (VSLED) unit to allow rapid fault isolation and on-condition maintenance. The aircraft is equipped to receive fuel from a probe and drogue air refueling system. Other installed

CURRENT IMPORTANT PROGRAMS

equipment includes forward looking infrared (FLIR), a secure voice radio, inertial navigation system (INS) and global positioning system (GPS) receivers. The CV-22 will have a multi-mode radar (MMR) with a terrain following/terrain avoidance (TF/TA) function, an expanded communications suite, an electronic warfare (EW) suite, an enhanced environmental system, additional fuel capabilities, and an enhanced avionics suite.

F-15 FIGHTER

The F-15 Development Test and Evaluation (DT&E) program provides general avionics laboratory and overhead support for the F-15 System Program Office DT&E program requirements. Specific program objectives, descriptions and requirements are in support of radar, avionics, and operational flight program (OFP) updates for the F-15A-E. The F-15 test aircraft at Edwards support a variety of non F-15 SPO programs such as Joint Helmet-Mounted Cueing System (JHMCS), AIM-9X, B-1B Avionics Testing and Engine Testing.

F-16 FIGHTER

The F-16 Follow-on DT&E program is a continuing effort to add significant new combat capabilities to all versions of the F-16 weapon system and correct previously identified deficiencies. Testing centers on the development and integration of new avionics and sensors and associated weapons to production blocks 30B, 40, 50 and several different commercial and foreign military sales versions of the aircraft. Testing will be conducted by a large test force and will involve virtually every technical discipline within the AFFTC mission.

The Modular Mission Computer (MMC) is an update for a common configuration for all Block 40 & 50 F-16s, which will enable pilot information superiority by employing sensor fusion technology to integrate a network of sensors and aircraft (Link-16, HTS-R7, color displays) and ensure aerospace dominance with integration of helmet mounted cueing with high off boresight weapons (JHMCS, AIM-9X) and increase precision engagement combat capability with integration of inertial aided weapons (JDAM, JSOW, WCMD) and the advanced targeting pod with combat ID. The F-16 weapon system is projected to be in the USAF combat inventory through 2020 and beyond.

Block 30 upgrades for Air National Guard (ANG) and Air Force Reserve (AFRES) F-16s will reduce active duty ops tempo while increasing our air expeditionary capabilities by providing ANG and AFRES forces with warfighting precision engagement (targeting pod, precision guided munitions, DTS, GPS). The upgrade will also act as a precision engagement force multiplier with integration of inertial aided munitions for guardsmen and reservists (GPS, JDAM, JSOW, WCMD) and enable aerospace dominance with information superiority aids (SADL).

Allied partnerships for our Joint Fighting Teams include Mid-Life Update, which provides precision engagement for Belgium, Norway, Denmark, and the Netherlands (targeting pod, precision guided munitions), Peace Fenghuang (Tiawan), Peace Xenia (Greece), Peace Vector (Egypt), Peace Marble (Israel), Peace Crown (Bahrain), and Peace Carvin (Singapore).

CURRENT IMPORTANT PROGRAMS

F-117 FIGHTER

The F-117 test program involves DT&E of new systems as well as logistics T&E of reliability and maintainability upgrades for incorporation into the F-117 fleet. DT&E centers on large programs known as Block Upgrades. The F-117 Combined Test Force recently completed all required testing for the Block 1 upgrade. Block 1 includes significant hardware and software upgrades such as a new Operational Flight Program (OFP-76), an updated Stores Management Processor (-14 SMP), and the Mid-Life Improvement Program #1 (MIP 1). The F-117 fleet is currently being upgraded to the Block 1 configuration at the depot facility in Palmdale, CA. Testing of the Enhanced GBU-27 (EGBU-27) was also recently completed. This weapon adds INS and GPS navigation aiding to the GBU-27 laser guided bomb, providing the first adverse-weather capability to the F-117. The requirement for this capability was identified in a Combat Mission Need Statement issued during Operation ALLIED FORCE.

Test planning continues for the Block 2 and 3 programs. Initial Block 2 testing is planned for FY02 with follow-on testing in FY05. Block 2 is a software update to incorporate full "smart weapon" capabilities on the aircraft, including the Joint Direct Attack Munition (JDAM) and full interface for the EGBU-27. Block 3 is a hardware and software upgrade to provide an updated infrared sensor system, improved multi-function displays, a new data transfer system, and structural enhancements. Testing is planned for FY05 through FY07.

The goals of the F-117 test program are to ensure the F-117 stealth fighter can be deployed anywhere in the world at a moments notice and carry out its intended mission: to employ stealth technology and precision weapon delivery on time and on target.

F-22 ADVANCED TACTICAL FIGHTER

The F-22 Advanced Tactical Fighter (ATF) will provide air dominance, with improved capability over current United States Air Force (USAF) aircraft. In addition, the F-22 will possess an inherent air-to-ground weapons employment capability. Beyond the turn of the century, the F-22 will be required to defeat the quantitative advantage, and emerging qualitative equivalency, of aircraft employed by air forces world wide. Using existing and emerging technologies, the F-22 will complement current USAF fighter performance for a clear advantage over future generation fighters. The overall development goal for the F-22 is to achieve a balance between performance, survivability, reliability and maintainability, and affordability. The Engineering and Manufacturing Development (EMD) phase of testing is currently ongoing at Edwards AFB; future EMD testing will include avionics testing, climatic tests, and Dedicated Initial Operational Test and Evaluation (IOT&E) testing.

JOINT STRIKE FIGHTER

The Joint Strike Fighter (JSF) Test and Evaluation (T&E) Support Office is responsible for all AFMC T&E support conducted in executing the JSF Concept Demonstration Phase (CDP) and planning for the Engineering and Manufacturing Development E&MD Phase. The JSF T&E Support Office provides a single point of contact for the member services, Office of the Secretary of Defense, AFMC and the Weapon Systems Contractors for AF T&E related matters. Specifically, the JSF T&E Support Office coordinates AFMC test facilities and T&E resources; provides input to the Test and Evaluation Master Plan and the Flight Certification Plan; helps coordinate the combined DT and OT activities; serves as

CURRENT IMPORTANT PROGRAMS

liaison between the Weapon Systems Contractors and government ground and flight test teams; helps coordinate the systems' safety requirements and helps develop and execute the Concept of Operations for the Concept Demonstration Aircraft. Personnel spread across the 412th Test Wing are currently accomplishing these actions. This proposed change would bring these people together and provide a single AFMC T&E team to support the customer needs.

LANTIRN

The test effort supports the continued development and refinement of the LANTIRN navigation and targeting pod. Efforts include continuing software development and area tracker testing.

BIG CROW

The mission of the Big Crow Program is to create electronic warfare environments for weapon system vulnerability assessments in both test and training situations. The systems have the capability to create the environment and to capture data required to do vulnerability assessments for DoD weapon systems and joint exercises. The capability is used extensively by all services, with the aircraft deploying all over the globe to execute their mission.

ADVANCED RANGE INSTRUMENTATION AIRCRAFT (ARIA)

ARIA supports a variety of DoD, National, NASA and commercial space-launch customers. The ARIA mission is to gather telemetry from booster and/or space launch payloads in locations of the globe that are inaccessible by other telemetry gathering assets. The captured data is used to verify correct orbital insertion and/or payload operation. If a problem occurs, ARIA data is often the only information from which programs can do failure analysis. ARIA's mission is world wide, with aircraft deploying from locations such as Ascension Island, Easter Island, Australia, Tahiti, and a long list of other remote sites.

UNMANNED AERIAL VEHICLE (UAV)

The High Altitude Endurance (HAE) UAV Program is an advanced concept technology demonstration aimed at developing and demonstrating long dwell, high-altitude tactical reconnaissance. Two HAE airborne components and a common ground segment are being developed under this program; a low observable HAE "Darkstar" and conventional design HAE "Global Hawk".

ACCESS TO SPACE PROGRAMS

AFFTC/RL will manage and act as the AFFTC focal point for the NASA X-32,X-33, X34, X-35, X-37, X-38, X40, X44 and subsequent Reusable Launch Vehicle (RLV) programs. The AFFTC will provide a cadre of personnel with experience in the development and testing of these types of vehicles and other transatmospheric/orbital spacelift programs. Numerous commercial access to space, reusable launch vehicle, and spaceplane ventures are currently in various stages of development and desire unique AFFTC engineering expertise or facility/extended range use.

CURRENT IMPORTANT PROGRAMS

AIRBORNE LASER (ABL)

The ABL will be a cost-effective, flexible weapon system that will provide a credible deterrent and a lethal defense against an increasingly proliferating theater ballistic missile threat (TBM). The ABL can be deployed with hours to any potential conflict, arriving in theater ready to provide an initial US deterrent and defensive capability for deploying US and/or allied forces. The ABL will be fully interoperable with other weapon systems in the joint theater missile defense architecture. The ABL weapon system orbits at high altitude. Through in-flight refueling and rotation of aircraft on combat air patrol, ABLs will provide near continuous 24-hour coverage of potential TBM launch sites. ABL's on board surveillance sensors can autonomously detect, acquire, and track multiple TBM launches, although cueing data from off-board sensors will be used when available within the short engagement timeline.

EQUIPMENT/FACILITIES

Major unique facilities and equipment include: Rogers Dry Lake, a natural landing field; ground-test capabilities: Integrated Facility for Avionics System Test (IFAST), Benefield Anechoic Facility (BAF), and Test & Evaluation Mission Simulator (TEMS) as part of the Electronic Combat Integrated Test (ECIT) complex; Edwards Flight Test Range (EFTR) which includes the real-time mission control facilities, Precision Impact Range Area (PIRA) used for bombing/gunnery/infrared systems integration, personnel and cargo parachute drop zones, photo resolution range, and instrumented low level terrain following course; hydrant refueling system for heavy aircraft; aircraft weight and balance facility complex; photo/video lab for airborne and ground testing; intermediate aircraft maintenance support capability; Pacer Comet jet engine test facility; horizontal aircraft thrust stand; and aircraft gun system harmonization range (GUNBUTT); Aircraft Dynamic Research, Engineering, Maintenance, Manufacturing, and Modification facility; Corrosion Control facility; Ridley Mission Control Center; and Test Pilot School (TPS).

Flight Test Center
Edwards AFB, CA 93524-1033
(805) 277-3229

Commander: Maj Gen Richard Reynolds
Executive Director: Mr. Les Bordelon

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	7.754	0.000	9.868	17.622
6.2	0.075	0.000	0.096	0.171
6.3	0.054	0.000	0.068	0.122
Subtotal (S&T)	**7.883**	**0.000**	**10.032**	**17.915**
6.4	3.623	0.000	4.612	8.235
6.5	42.273	0.000	34.962	77.235
6.6	172.388	0.500	234.085	406.973
6.7	25.102	0.000	20.761	45.863
Non-DOD	6.932	0.000	8.822	15.754
TOTAL RDT&E	**258.201**	**0.500**	**313.274**	**571.975**
Procurement	4.440	N/A	4.024	8.464
Operations & Maintenance	132.900	N/A	52.200	185.100
Other	53.181	N/A	9.974	63.155
TOTAL FUNDING	**448.722**	**0.500**	**379.472**	**828.694**

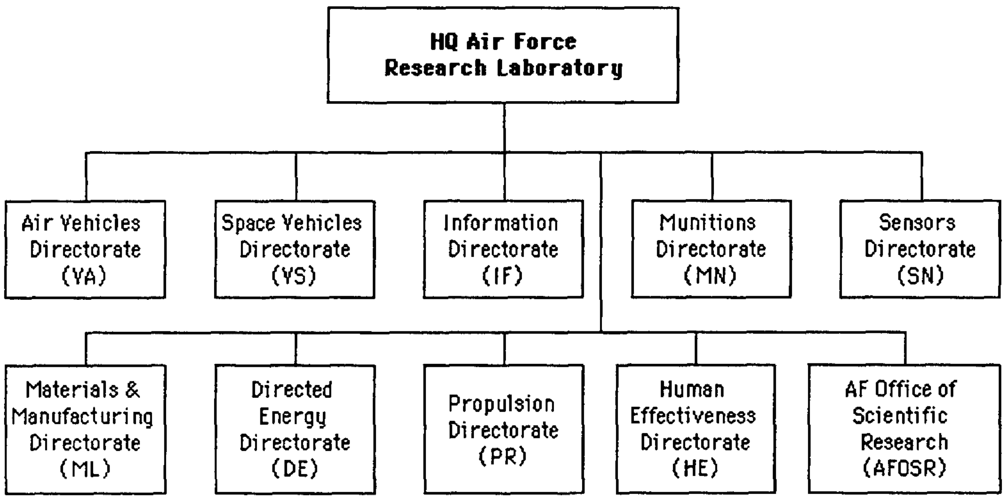
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	32.100

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	3385	3385
CIVILIAN	8	522	2169	2699
TOTAL	**8**	**522**	**5554**	**6084**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	343.102	**REAL PROPERTY**	875.170
ADMIN	279.470	* NEW CAPITAL EQUIPMENT	0.000
OTHER	8788.327	**EQUIPMENT**	278.460
TOTAL	**9410.899**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**297732**	* Subset of previous category.	

HQ Air Force Research Laboratory

FY2000 Abbreviated Functional Chart - Technical Organizations



HQ Air Force Research Laboratory
Wright-Patterson AFB, OH 45433-7131
(937) 904-9000

Commander: Brigadier General Paul Nielsen
Senior Executive Service: Mr. Robert J. May

MISSION

Leading the discovery, development, and integration of affordable warfighting technologies for our aerospace forces.

CURRENT IMPORTANT PROGRAMS

The AFRL is taking last year's process a step further and introducing the concept of Critical Future Capabilities (CFCs). CFCs are comprised of 6 core competencies and 3 core support competencies. They help define the Warfighter needs and deficiencies; CFCs are tied to the Integrated Technology Thrusts (ITTs) through the Integrated Technology Thrust Programs (ITTPs). Advanced Technical Demonstrators (ATDs) are also related directly to ITTPs and can be binned into CFCs. The matrix formed by the above related terms is used to define what a given organization uses to describe the Science & Technology (S&T) associated with what the Warfighter requires. This is so all organizations can understand what each is describing, in their own particular terminology. Therefore, new products for warfighting can be designed and implemented with a minimum of confusion. The following are AFRL ITTPs as they are related to CFCs:

Command and Control (C2) (Data Manipulation) CFC: Dynamic C2, Configurable Command Centers (C3), and Defensive Information Warfare ITTPs.

Aerospace Superiority CFC: Space Systems Survivability, Micro Satellites, Military Space Plane (MSP), and Space Optics & Lasers ITTPs; and Unmanned Combat Aerial Vehicle (UCAV) are the applicable ITTPs. The following are the related Category 1 ATDs: EELV Secondary Payload Adapter (ESPA), Advanced SEAD Targeting, and ATFE F119 Upgrade.

Information Superiority (Communications and Active Command & Control, Intelligence, Surveillance & Reconnaissance (AC2ISR Platforms) (Data Collection, Organizing, and Transmission) CFC: Global Grid, Consistent Battlespace Picture, Hyperspectral Imaging (HSI), and Space Based Radar Advanced Moving Target Indicator (SBR-AMTI) are the applicable ITTPs. The following are the related Category 1 ATDs: Warfighter 1, High Performance LWIR for Space Sensors, Improved Space Computer Program, Advanced Multijunction Solar Cells, Cognitive Desktop Information Manager, Adaptive Sensor Fusion, Situation Aware From Enhanced Threat Info (SAFETI), Spectral Infrared Remote Imaging Transition Testbed (SPIRITT) Day, Moving Target Indicator Exploitation Tools, Intermediate Text Exploitation, Multi Domain Network Management, and Hyperspectral Information Fusion.

Global Attack CFC: Signature Technology is the related ITTP. The following ATDs are applicable: Future Air Navigation and Traffic Avoidance Solution Through Integrated CNS (FANTASTIC), Next Generation Transparency, and ATFE F120 Upgrade.

CURRENT IMPORTANT PROGRAMS

Precision Engagement CFC: Hard Target Munitions, Strike Helmet 21, Sensor Protection, Miniature Munitions, Targets Under Trees (TUT), Electronic Warfare (EW), and Air-to-Ground Combat Identification (ID) are the applicable ITTPs. The following Category 1 ATDs are related: Advanced Laser Eye Protection (ALEP), Enhanced Recognition & Sensing Radar (ERASER), and Electro Optical (EO) Target Detect, Loc, Non-Coop ID (JOANNA).

Rapid Global Mobility CFC: Laser Infrared Fly-out Experiment (LIFE, formerly LAIRCOM) ITTPs. There were no related Category 1 ATDs.

Agile Combat Support (ACS) CFC: High Cycle Fatigue (HCF), Low Observables (LO) Maintainability, Combat Logistic Tools, Aging Aircraft Structures, Turbine Engine Durability (TED), Deployed Base Support Technology, Distributed Mission Training (DMT), and Active Denial Technology (ADT) were the applicable ITTPs. The following Category 1 ATDs are related: Corrosion Effects on Structural Integrity, Advanced NDE for Aging Structures, Bonded Repair Capability Enhancements, and Advanced Aircraft Corrosion Protection.

Innovation Support CFC: None.

Quality People Support CFC: None.

EQUIPMENT/FACILITIES

Total of $57,111.42 all inclusive.

HQ Air Force Research Laboratory
Wright-Patterson AFB, OH 45433-7131
(937) 904-9000

Commander: Brigadier General Paul Nielsen
Senior Executive Service: Mr. Robert J. May

FY2000 FUNDING DATA (MILLIONS $)

APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	5.420	0.000	5.420
6.2	0.000	23.224	0.000	23.224
6.3	0.000	7.680	0.000	7.680
Subtotal (S&T)	**0.000**	**36.324**	**0.000**	**36.324**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	0.000	0.000
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**0.000**	**36.324**	**0.000**	**36.324**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	0.000	N/A	0.000	0.000
TOTAL FUNDING	**0.000**	**36.324**	**0.000**	**36.324**

MILITARY CONSTRUCTION (MILLIONS $)

Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)

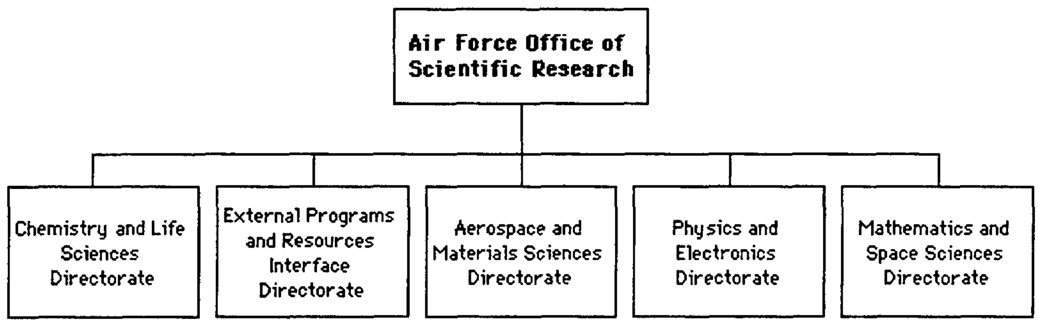
TYPE	SCIENTISTS & ENGINEERS: DOCTORATES	SCIENTISTS & ENGINEERS: OTHER	TECHNICAL SUPPORT & OTHER PERSONNEL	END STRENGTH
MILITARY	4	40	27	71
CIVILIAN	5	52	107	164
TOTAL	**9**	**92**	**134**	**235**

SPACE AND PROPERTY

BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	0.000	**REAL PROPERTY**	1.914
ADMIN	49.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	0.000	**EQUIPMENT**	1.400
TOTAL	**49.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	1	* Subset of previous category.	

Air Force Office of Scientific Research

FY2000 Abbreviated Functional Chart - Technical Organizations



Air Force Office of Scientific Research
Arlington, VA 22203-1977
(703) 696-7550

Commander: Col Steven Reznick
Director: Dr. Joseph F. Janni

MISSION

AFOSR manages the entire basic research investment of the US Air Force. Plans, coordinates, and executes the Air Force Research Laboratory's (AFRL) basic research program in response to technical guidance from AFRL and requirments of the Air Force. Fosters, supports, and conducts research within the Air Force, university, and industry laboratories. Ensures the transition of research results to support USAF needs.

CURRENT IMPORTANT PROGRAMS

The AFOSR research program is responsible for funding broad-based scientific and engineering basic research in technologies critical to the Air Force mission. These technologies include aerospace structures, aerodynamics, materials, propulsion, power, electronics, computer science, directed energy, conventional weapons, life sciences, and atmospheric and space sciences. All projects are coordinated through the reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds. All technology areas are subject to long-range research planning and technical review by tri-service scientific planning groups that interface and support the Defense Technology Area Planning process. The AFOSR basic research program is divided into the following twelve scientific projects and one educational project:

PROJECT	TITLE
2301	Physics
2302	Solid Mechanics and Structures
2303	Chemistry
2304	Mathematical and Computer Sciences
2305	Electronics
2306	Structural Materials
2307	Fluid Mechanics
2308	Propulsion
2310	Atmospheric Sciences
2311	Space Sciences
2312	Biological Sciences
2313	Human Performance
4113	External Programs and Resources Interface

2301 Physics: Physics research provides the fundamental understanding to improve technologies critical to Air Force lasers, avionics, and microwaves. The research enables improvements in electromagnetic countermeasures, protection against nuclear weapons effects, communications, small satellites, and non-destructive, and non-intrusive testing and analysis. It also supports the development of new sensors. The primary areas of research investigated by this project are laser and optical physics; atomic, molecular, and imaging physics; and plasma physics.

CURRENT IMPORTANT PROGRAMS

2302 Solid Mechanics and Structures: Solid Mechanics and Structures basic research aims to drastically improve the behavior of aerospace materials and structures by better describing how they wear and are damaged. It also expands fundamental knowledge of the aero-elastic and acoustic behavior of airframes and engine structures, and the dynamic behavior of launch vehicles and space structures. The goal is the cost-effective development, and safe, reliable operation of superior Air Force weapons and defensive systems. Research topics include: the design of advanced material structures on a micro scale; modeling and simulation of the dynamic behavior of aircraft, missiles, and large space structures; and technology integration for the performance and survivability enhancement of these systems. The primary areas of research investigated by this project are mechanics of composite materials, structural mechanics, and structural dynamics.

2303 Chemistry: Chemistry research seeks bold innovation in understanding and controlling chemical reactions to develop new materials, improve synthesis of existing materials, control energy flow and storage, and control the interaction between materials and their environments. Studies address chemical dynamics and energy transfer processes that foster advances in laser weaponry, allow predicting infrared, optical and radar signatures, and enable the synthesis of new chemical propellants. Critical research topics include novel synthesis and characterization of lower cost and higher performance functional and structural materials, electronic and photonic materials, nano-structures, electromagnetic and conventional weaponry, and propellants. Focused investigations include the effects of chemical and morphological structures on functional and mechanical properties of polymeric materials, and the exploration of atomic and molecular surface interactions that limit performance of electronic devices, compact power sources, and lubricant materials. The primary areas of research are molecular dynamics and theoretical chemistry, polymer chemistry, and surface and interfacial science.

2304 Mathematical and Computer Sciences: Mathematics research expands techniques for mathematical modeling, simulation, and control of complex systems, and develops innovative analytical and computational methods for aerospace systems. Research provides improved performance and control of aerospace systems through accurate models and computational tools, artificial intelligence, and improved programming techniques and theories. The primary areas of research investigated by this project are dynamics and control, physical mathematics and applied analysis, computational mathematics, optimization and discrete mathematics, signals communication and surveillance, systems and software, and external aerodynamics and hypersonics.

2305 Electronics: Electronics research builds a fundamental understanding of electronic materials, devices, and systems to advance Air Force operational capabilities in directed energy weapons, stealth technologies, electronic countermeasures, information and signal processing, and communications. The focus is on developing electronic processes to model and predict performance of electronic materials, devices, and systems for power generation, optical signal processing, radiation effects, and high-speed signal processing. The goals are to firmly control the complexity and reliability of electronic systems, increase data transmission and information processing speeds of Air Force systems, and improve the security and reliability of electronic information. The primary areas of research investigated by this project are space electronics, optoelectronic materials, optoelectronic information processing, and quantum electronic solids.

CURRENT IMPORTANT PROGRAMS

2306 Materials: Materials research enhances the performance, cost, and reliability of structural materials to eliminate material reliability issues related to high-temperature strength, toughness, fatigue, and environmental conditions. Examination of material strength, toughness, fatigue resistance, and corrosion resistance will enable novel materials for airframe, turbine engine, and spacecraft structures. Emphasis is on refractory alloys, inter-metallics, polymer composites, metal and ceramic matrix composites, and advanced ceramics, such as alumina, silicon carbide, silicon nitride, and carbon/carbon. Research seeks to develop improved aerospace vehicle structural materials, increase the operating temperature of engine materials, which will further increase thrust-to-weight ratio of engines. Research in new processing methods complements research on materials properties. The primary areas investigated by this project are ceramic and non-metallic materials, metallic materials, and organic matrix composites.

2307 Fluid Mechanics: Fluid Mechanics research advances fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of aerospace vehicles. Understanding of key fluid flow (primarily high-speed air) phenomena is directed to improve theoretical models for aerodynamic prediction and design, and to originate flow control concepts and predictive methods to expand current flight performance boundaries. The emphasis is on turbulence prediction and control, unsteady and separated flows, hypersonics, and internal fluid dynamics. The primary approach is to formulate advanced computational methods to simulate and study complex flows, predict real gas effects in high-speed flight, and control and predict turbulence in flight vehicles and propulsion systems. The primary areas of research investigated by this project are unsteady aerodynamics, hypersonic aerodynamics, turbulence and flow control, and rotating flows.

2308 Propulsion: Propulsion research seeks the efficient utilization of energy in airbreathing engines, chemical and non-chemical rockets, and combined cycle propulsion systems for access to space. Research thrusts include airbreathing propulsion, space power and propulsion, high altitude signature characterization and contamination, propulsion diagnostics, and thermal management of space-based power and propulsion systems. Chemically reacting flow and non-chemical energetics are investigated. Study of chemically reacting flows involves the complex coupling between energy release through chemical reaction and the flow processes that transport chemical reactants, products, and energy. Non-chemical energetic systems include plasma and beamed energy propulsion for orbit raising space missions, and efficient ultra-high energy techniques for space-based energy utilization. The primary areas of research investigated by this project are space power and propulsion, combustion, and diagnostics.

2310 Atmospheric Sciences: Upper Atmospheric research characterizes the Earth's upper atmosphere to predict and control its effects on Air Force tactical and strategic operations. The goal is to accurately model ionospheric irregularities and thermospheric dynamics to provide reliable, continuous communications, command, and control. Innovative techniques enable evaluation of the structure and chemistry of the mesosphere and thermosphere, and modeling of the physics and dynamics of the ionosphere to enhance global surveillance, geolocation, and communication capabilities. Focused investigations include observation and modeling of atmospheric tides and gravity waves, geomagnetic disturbances, auroral and airglow emissions, and plasma turbulence and dynamics. The primary areas of research investigated by this project are space weather, optical and auroral emission, and ionospheric scintillation and turbulence.

CURRENT IMPORTANT PROGRAMS

2311 Space Sciences: Space Sciences research provides fundamental understanding of the space environment for optimum design of Air Force systems operating in near-Earth orbit, geosynchronous orbit, and deep space. The goal is to enable protection of space assets from space debris, solar wind, solar flares, cosmic rays, and geomagnetic storms. Focus is on specifying the flow of mass, momentum, and energy through space to develop a global model that connects solar activity with the deposition of energy at the Earth. Methods are developed to forecast the turbulent plasma phenomena that mediate the flow of energy through space, in order to enhance the effectiveness of Air Force global dominance through space operations. The primary areas of research investigated by this project are astrophysical observation techniques, solar physics, solar wind transport, magnetospheric physics, magnetosphere-ionosphere coupling, ionospheric physics and scintillation, and energization processes in the Earth's radiation belts.

2312 Biological Sciences: Biological Science research explores the interaction of Air Force chemicals and physical agents (lasers and microwaves) with human tissues and their production of toxic effects to enable safety assessment strategies and to ensure the hazard-free development and use of future aerospace materials and directed energy systems. Research in biomimetic sensors strives to understand the biological detection systems of organisms at the molecular level and apply this understanding to the development of novel man-made sensors. Biocatalysis research aims to discover and characterize cellular enzymes that will catalyze the synthesis of chemical feedstocks used in the safe production of space and aerospace materials. Research in neuroscience and chronobiology will result in new strategies to prevent impaired performance due to jet lag and shift-work, night operations, and the loss of life and/or aircraft due to stress, inattention, or lack of vigilance. The primary areas of research investigated by this project are bioenvironmental sciences, biocatalysis, chronobiology and neural adaptation, and biomimetic sensors.

2313 Human Performance: Human Performance research examines all aspects of human information processing critical to Air Force operations. The overall objective is to develop useful, quantitative models of the way people: perceive, navigate, and manipulate their environment; make decisions in complex tasks under stress or uncertainty; and adapt to extreme sensory, biophysical, or cognitive workloads. The sensory component emphasizes visual, auditory, vestibular, and kinesthetic systems and their optimal integration. Focused investigations seek the scientific foundation for several developing Air Force technologies including the design of interactive displays, virtual reality simulators, intelligent control systems, sensors and fused-image displays, and adaptive systems for personnel training and selection. The primary areas of research investigated by this project are sensory and perceptual systems, cognition, and cognitive workload.

4113 External Programs and Resources Interface: International and domestic interchange research programs optimize the interaction between the international and domestic research community and Air Force researchers, and stimulate scientific and engineering education beneficial to the Air Force. The programs increase the awareness of Air Force basic research priorities and attracts talented scientists and engineers to address its needs. The primary elements of this effort are international strategy, international technology liaison, and scientist and engineer research interchange.

EQUIPMENT/FACILITIES

Primary operating location is Arlington, VA.

Overseas detachments are maintained in London, UK, and Tokyo, Japan.

Air Force Office of Scientific Research
Arlington, VA 22203-1977
(703) 696-7550

Commander: Col Steven Reznick
Director: Dr. Joseph F. Janni

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	64.891	151.414	216.305
6.2	0.000	0.000	0.000	0.000
6.3	0.000	0.000	0.000	0.000
Subtotal (S&T)	**0.000**	**64.891**	**151.414**	**216.305**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	0.000	0.000
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**0.000**	**64.891**	**151.414**	**216.305**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	0.000	N/A	129.400	129.400
TOTAL FUNDING	**0.000**	**64.891**	**280.814**	**345.705**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	12	5	10	27
CIVILIAN	37	6	60	103
TOTAL	**49**	**11**	**70**	**130**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	0.000	**REAL PROPERTY**	0.000
ADMIN	25.250	* NEW CAPITAL EQUIPMENT	0.000
OTHER	0.000	**EQUIPMENT**	0.000
TOTAL	**25.250**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**0**	* Subset of previous category.	

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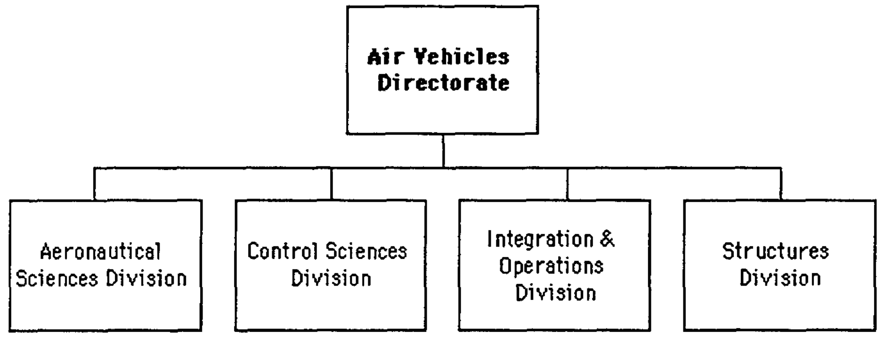
Air Vehicles Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Air Vehicles Directorate
Wright-Patterson AFB, OH 45433-7542
(937) 255-4012

Director: Colonel David E. Walker
Associate Director: Dr. William U. Borger

MISSION

AIR VEHICLES DIRECTORATE

Plans, formulates and directs U.S. science & technology for research, exploratory, and advanced technology development for military air vehicles. Orchestrates/executes technology developments in aeronautical sciences, control sciences, and aerospace structures. Integrates air vehicle technologies with all other AFRL directorates at the systems level. Provides technical support for the integration of aerospace systems for ALCs & SPOs. Orchestrates this technology development with other DoD and national laboratories, industry, universities, NASA, FAA, NATO, and other foreign research organizations.

AERONAUTICAL SCIENCES DIVISION

Performs basic research, exploratory development, and advanced development in aerodynamic configurations, physics-based modeling and simulation, and aerospace vehicle integration and demonstration to support the Air Vehicles Directorate's focus areas of aircraft sustainment, uninhabited air vehicles, and space access and future strike technologies. Transitions technology results and products to major Air Force commands, other government organizations and industry through in-house and contracted efforts, consultation to user programs, and participation in professional organizations. Leads a partnership of government, industry, and academia to develop aero-science technology to greatly enhance warfighter capability in the 21st Century.

CONTROL SCIENCES DIVISION

Plans, programs, manages, and directs basic, exploratory, and advanced development programs to develop, demonstrate, and transition innovative advanced control sciences technologies to support the Air Vehicles Directorate mission. Advances capabilities in control theory, flight control component and system technologies, and flight vehicle simulation and assessment in concert with the directorate's focus areas of aircraft sustainment, uninhabited air vehicles, and space access and future strike technology. Transitions information and products to major Air Force commands, other government organizations, industry, and academia through in-house and contracted efforts. Provides consultation and support for Air force operational and development systems and actively participates in professional organizations. Represents the Air Force in advancement of control science technologies with other national and international agencies.

STRUCTURES DIVISION

Plans, directs, manages, and performs basic research, exploratory development, and advanced development in air vehicle structural design, structural technology integration, analytical structural mechanics, structural dynamics, sustainment, and extreme combined environment structures to solve critical structural problems on fixed-wing aerospace vehicles. Supports the Air Vehicles Directorate's integrating concepts of aircraft sustainment, uninhabited air vehicles, and future strike/space operating vehicles. Transitions technology results and products to major Air Force commands, other government organizations and industry through in-house and contracted efforts, consultation to System Program Offices, Air Logistics Centers, and other AFRL Directorates, and through participation in professional organizations. Provides technical advice and support to other DoD organizations and government agencies.

CURRENT IMPORTANT PROGRAMS

AERONAUTICAL SCIENCES DIVISION

Boundary Layer Receptivity, Active Flow Control, Multidisciplinary Computational Aerodynamics, Computational Electromagnetics, Magnetohyrodynamics (MHD) Hypersonics, Computational Coil Initiative, Computational Hypersonics, High Resolution Codes for CEA, Parallel Cobalt Development, F-18 Abrupt Wing Stall, Multi-Disciplinary Computing Environment (MDICE), Multi-Disciplinary Design Optimization using CFD (MDOPT), Internal Flow Control (IFC), Inlet Aerostructural Integration (IAI), Active Robust Control of Internal Cavities (ARTIC), DERA, VAA Acoustic Suppression Joint Research, Air-to-Air Collision Avoidance (ACAS), Technology Assessment Architecture Refinement, UCAV ATD, Active Core Exhaust (ACE), Nozzle Flow Control, Filtered Rayleigh Scattering Velocimetry for Wind Tunnel Applications, Expandable Expert System for CDF, Active Flow Control for Aero Enhancement, Active Skin Friction Drag Reduction, Turbulent Sensitivity Analysis for Enhancing Future Aircraft, Active Separation Control for Improved Weapon Separation Characteristics, Smart Surface for Flow Control, Multi-Variable Sensitivity Technology for Enhancing Future Aircraft, Electron Beam-Controlled Microwave-Driven Plasmas for Hypersonic Flow Control, MGD/MHD Inlet Flow Control for Advanced Hypersonic Vehicles, Skytote: An Innovative Aircraft with Unique Performance Capabilities, Active Flow Control to Improve Inlet Performance, MHD Control of Boundary Layer Transition in External Hypersonic Flows, Active Control of Compact Diffusing Inlets Using SMA-Actuated Micro-Vortex Generators, High Frequency Suppression of Acoustic Resonance for Weapons Bays, Computational Tool for Advanced Transition Prediction, Single S/W Application for Comprehensive Analysis of UCAV S&C Characteristics, Actively Controlled Multi-Winglets, Low Speed Testing and Simulation Modeling for Powered Configurations, Pressure Sensitive Paint for Low Speed Flows.

CONTROL SCIENCES DIVISION

Verification and Validation of Integrated and Adaptive Control Systems, Adaptive Guidance Systems for Hypersonic Vehicles with Reconfigurable Inner-Loop Control, Aeronautical Sciences and Flight Control Technology for Military Aerospace Vehicles, Testbed for Air Vehicle Coordination Techniques (TACT), Adaptive Guidance and Control for Autonomous Hypersonic Vehicles, Large Number of Air Vehicles Simulation (LNAVSIM), Simulation Based R&D for Space Vehicle Concepts, A Methodology for Unsteady Aerodynamic Modeling, Light Controlled Power Semiconductors for Flight Control Actuation, Integrated Electric Actuation, Flight Control Actuation In-Service Health Monitor, Multi-Vehicle Aerodynamics Model, MALI Neural Network Development and Flight Test, Multivariable Control Systems, Advanced Vehicle Management Technology, SOV Integrated Systems, UAV Mission Sim Development, Next Generation Transparency, Engine Nacelle Ballistic Fire Protection, UAV Autonomous Control, More Electric Aircraft Technology Validation, JSF Integrated Subsystems Technology, Reactive Switching Strategies for UAVs, Design of Hierachical Hybrid Control Systems, High Confidence Reconfigurable Distributed Control, Vulnerability Assessment MELVAN, Aerial Resupply for UCAV, Compact Hybrid Actuation, LO Air Data, X-38/X43. Side Stick Control, NAIC Support, Technology for Reliable Autonomous Control, Hybrid System Design Tools for Multi-Agent MM Control, Autonomous Mult-Vehicle Control Systems, Auto Hi Perf Control Technology, Real-Time Aggressive Control of UAVs, Compositional Abastraction and Refinement Aspects, Aspect-oriented Composition of Embedded Systems, Automatic Derivation, Integration and Verification of Synchronization Aspects in Object-oriented DE, Temporally Aware Reactive Programs, I/O Intensive Embedded Systems: The Infopipe Approach, Aspect Suites for Mission Critical Systems, JSF.

CURRENT IMPORTANT PROGRAMS

STRUCTURES DIVISION

Widespread Fatigue Damage Evaluation, Load Redistribution/Shedding Due to MSD, Impact of Parameter Accuracy on Predicted Life, Damage Tolerant Design Handbook/Crack Growth Database, C-5 Material Characterization, Built-up Structure Small Crack Study, Retrofit of Fail Safety, Mixed Mode Failure Criterion, Search Peening for Corrosion, Determination of residual stresses induced by rivet installation, Strip-Yield Model Implementation into AFGROW, External K Solver, Multiple Crack Growth, AFGROW Development and Validation, Life Extension Techniques Assessment, Durability Patch Program, Sponsored/Funded Repair Efforts (Shear Modulus Measurement and Cyclic Stress Durability of Bonded Joints, Phenomena in repairs to thicker stiffened structures, Pre-loaded repairs, Bonded repairs to curved surfaces), Structural Health Monitoring, Combined Environment Testing Software (CETS) Development, CMC Repair, TPS Concepts, CMC Design Criteria, Thin Film Heat Transfer, C/SiC CMC Standoff TPS, Mechanically Attached Blanket TPS, Oxide CMC Wrapped Tile TPS, Hybrid Structures for Efficient Combined TPS & Mechanical Performance, Repair of Ceramic Matrix Composite Structures, Titanium Matrix Composites Material Characterization & Failure Prediction, Combustor Box Test, Actively Cooled Panel Test, Development of Design Methods for High Temperature Composite Joints, HBCU Thermal Structural Interaction Effects in Composites, Advanced Composite Elevated Temperature Structure, Composite Repair of Aircraft Structure, Analytical Certification of Aircraft Structure, Composites Affordability Initiative, Continuous Moldline Technology (CMT) Flight Demo, Corrosion Fatigue Structural Demonstration, Coupling ASTROS to Contemporary Aerodynamic Codes, Dynamics, Dynamics - Acoustics, Dynamics - Buffet/Vibration Suppression, Evaluation of Computational Aeroelasticity Codes, Identification of Critical Flight Loads, Life Enhancement Methods - Life Extension Techniques, Low Cost Foam Edge Structure, Non-Oxidizing Refractory Composite Tanks and Structures (N0RCTS) Program (CMC LOX Tank DUST), Polymeric Foam Core Structure, Prediction and Control of Twin Tail Buffet of Fighter Aircraft, Reduced-Order Modeling - Proper Orthogonal Decomposition, Robust Composite Sandwich Structures, Structurally Integrated Thermal Energy Management (SITE-M), Survivable Aircraft Structures Technology, The Active Aeroelastic Wing Research Program, Weapons Bay Noise Suppression, Web-based Design Environment, C/SiC Standoff, CMC Wrapped Tile TPS, (Multidisciplinary Computing Environment) MDICE - Aeroelasticity, Characterization of aeroacoustic/combustion loads, response of thermally buckled panels, Sonic fatigue of CMC panels, Visual crack monitoring system, Identification of nonlinear models from experimental data, DARPA Smart Wing, Variable Stiffness Spar, High L/D Active (HiL/DA) Wing, Adaptive Compliant Wing, Morphing Aircraft, Tiltwing Transport CRDA (Boeing), Sensorcraft Concept Study, Reusable Military Launch System Concept Studies, Directed Energy Concept Studies, AML Design Modeling for RMLS Concepts CRDA (TSI), Supersonic/Hypersonic Vehicle Design Sim Sys, Aerothermoelastic Opt Meth for Reusbl Launch Veh, UAV Design Modeling, Simulation-Based Affordability Assessment Tool, Air Vehicle Technology M&S (TSI & Purdue), Analysis of Limit Cycle Oscillation with CAP-TSD, Analysis of Limit Cycle Oscillation with ENS3DAE, Innovative Aeroelastic Concepts, Reduced-Order Modeling of Nonlinear Systems, Reduced-Order Modeling of Aeroelastic Systems, Pervasive DAGSI Developments for Space, Pervasive DAGSI Developments for UAV's , Multi Inter Design/Analysis, Coupling of ASTROS to Contemporary Aero Codes, ASTROS CRDA, Energy-based Design, Prob Mod Non-lin MD Integ, Improved Methodology for Advanced Aircraft Design, Survivability of Low Cost Composites, Op A/C Flightline Stru Health Assessment/Maint Decision Sys for Life Cycle Mgt and Analysis Assisted Cert, Innovative Mats and Struc Concepts for Surv of UCAVs, In-House Support and Overset capability for ENS3DA, Prediction and Control of Buffet, Design for Limited Life Airframes, Hybrid Clevis Joints, Multifunctional Structures, TYCOR Sandwich Structure, Composite Grid Lock Structure, Deformation Compensation for CLAS, Large, Low Frequency CLAS, Criteria for Z-Pinned Structure, Criteria for

CURRENT IMPORTANT PROGRAMS

Woven Structure, Integrally Woven Bias Ply Structure, Electron Beam Cured Structures, Innovative Composite Process Modeling using AML, Next Generation Transparency, JSF/T-6/F-22 Test Support, Narrow Body Aft Pressure Bulkhead test, CAFS, X-37 Pathfinder, ATROHS, High Temp Combustion Liner Test, High Speed Data Buffer, and Ignitron Electrical Power/Heat Control Research.

EQUIPMENT/FACILITIES

An F-16 Variable Stability In-Flight Simulator Test Aircraft (VISTA) and a Total In-Flight Simulator (TIFS) Test Aircraft.

LAMARS - Large Amplitude Multimode Aerospace Simulator, a one-of-a-kind 20" diameter motion base simulator dome providing large amplitude, high fidelity, and five degree-of-freedom motion simulator.

Flight Control Actuation System Facility - Only US facility with test rig that can evaluate linear actuators under static and dynamic (high - bandwidth - up to 100 Hz) loads up to 100,000 pounds.

Hydrogen Test Facility - Specifically designed to experimentally simulate the thermal environment of airframe and engine hydrogen actively cooled structures or small cryogenic tankage. Fluids available include both hydrogen and helium. Heat source provided by a plasma arc heater, which provides an impinged heat flux up to 2000 BTU/FT2/Sec.

Fatigue and Fracture Extreme Environment Facility - Provides combined thermal/mechanical fatigue testing under controlled temperatures from -200 to 2200 F. Altitudes may be simulated from sea level to 150,000 ft with flexibility to simultaneously mix up to four separate gases. Specimens up to 4 inches wide including complex structural joints may be tested.

Combined Environment Acoustic Chamber - Conducts high temperature acoustic response and fatigue testing of structural components. The facility can produce a heat flux of 50 BTU/Ft2/Sec in 170 dB overall sound pressure level creating temperatures as high as 2500 F. Test specimen up to 4 X 10 feet may be accomplished.

Large Acoustic Test Facility - Used to conduct fatigue testing of aerospace structures and components. The test chamber is 20 x 56 ft and could be configured to test full-scale aerospace vehicles and components in a reverberate of anechoic mode.

Vertical Wind Tunnel (VST) - Features the capability, unique to US, of simultaneous acquisition of both rotary balance and forced oscillation wind tunnel data using the same model. This capability enables researchers to efficiently acquire both sets of dynamic data, crucial to the study of aircraft control under extreme maneuvering conditions, with one test entry. Current research is exploring the potential of combing the two motions to simulate more flight representative motions of highly agile aircraft.

EQUIPMENT/FACILITIES
Subsonic Aerodynamic Research Laboratory (SARL) - Unique in the US for its: (1) extremely low (< .1%) test section turbulence levels achieved by a large, 36:1 contraction ratio coupled with a honeycomb and six fine mesh screens, (2) max viewing area (55% of test section walls are transparent to enable unique non-intrusive advanced diagnostic flow visualization, (3) high model attitude (-5/45 degree angle of attack, -10/+10 degree angle of yaw, -185/=185 degree angle of roll coupled with (4) high aerodynamic load capability (8000, 2200 and 1000 pound normal, axial and side force respectively).

Air Vehicles Directorate
Wright-Patterson AFB, OH 45433-7542
(937) 255-4012

Director: Colonel David E. Walker
Associate Director: Dr. William U. Borger

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	2.376	1.006	0.506	3.888
6.2	31.873	5.230	7.123	44.226
6.3	4.184	1.153	21.777	27.114
Subtotal (S&T)	**38.433**	**7.389**	**29.406**	**75.228**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	9.641	9.641
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**38.433**	**7.389**	**39.047**	**84.869**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	5.020	N/A	0.000	5.020
Other	17.260	N/A	0.000	17.260
TOTAL FUNDING	**60.713**	**7.389**	**39.047**	**107.149**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	
TYPE	DOCTORATES	OTHER		END STRENGTH
MILITARY	4	31	6	41
CIVILIAN	49	151	80	280
TOTAL	**53**	**182**	**86**	**321**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	358.519	**REAL PROPERTY**	306.476
ADMIN	132.612	* NEW CAPITAL EQUIPMENT	0.000
OTHER	110.460	**EQUIPMENT**	855.671
TOTAL	**601.591**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**36**	* Subset of previous category.	

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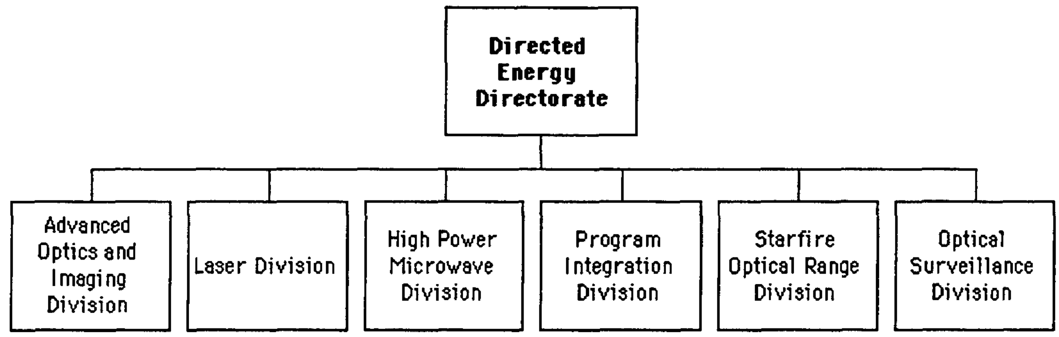
Directed Energy Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Directed Energy Directorate
Kirtland AFB, NM 87117-5776
(505) 846-1911

Director: Dr. R. Earl Good
Deputy Director: Col Douglas Beason

MISSION

Develop, integrate, and transition science and technology for Directed Energy to include high power microwaves, lasers, adaptive optics, imaging and effects to assure the preeminence of U.S. in air and space.

CURRENT IMPORTANT PROGRAMS

Laser Technology verifies the feasibility and payoff of lasers in advanced weapon, communication, remote sensing, aircraft self-protection and optical countermeasure applications. Development efforts continue to address the concerns of scaling to high power, good beam quality, high efficiency, lethality and vulnerability. Systems level issues significantly influence the development effort. Affordability, reliability, packaging for minimum weight/volume, and laser suitability for particular applications and operational environments are all critical issues receiving increased emphasis. Chemical lasers have demonstrated many crucial attributes, particularly scalability, and will be the device of choice in the near term. However, ongoing research in solid state lasers offers promising technology to meet the increasingly rigorous demands of small size, low logistics impact, reduced life cycle cost and multifunctional capability in future Expeditionary Aerospace Force roles.

Beam Control Technology involves the development and transition of advanced optical systems for laser propagation and real-time high resolution imaging applications. Primary applications include ground-based laser anti-satellite weapons, the airborne laser, and ground-based imaging of LEO satellites for space surveillance and diagnostics. Work is focused on development and field tests of laser beacon adaptive optics, precision beam pointing for aimpoint control, and high accuracy target acquisition and tracking, including active tracking for 24-hour operations.

Advanced Optics and Imaging Technology involves the development and transition of multi-spectral sensing and image processing technologies for high resolution imaging applications. Advanced optics and imaging technology also involves the development of large optics and their optical compensation for large mirror-based applications. This technology takes advantage of adaptive optics and target acquisition/tracking technologies developed under the Beam Control technology to produce a compensated, stabilized image, which can then be further improved with advanced imaging sensors and post-processing of the image. Advanced concepts, which can reconstruct images from interferometric or speckle data, are also being pursued.

High Power Microwaves (HPM) Technology develops and demonstrates HPM technology to disrupt, degrade, and destroy electronics in various systems such as communications, information, or weapon systems to support warfare missions. Adversaries will be denied use of electronic information processing, communications or weapons systems by using high-peak power (damage) and high-average power (disruption) microwave sources packaged for an air-deliverable bomb, submunition, portable device or unmanned aerial vehicle (UAV). Technology development efforts will initially concentrate on portable (short-range) or heavy transportable weapons for command and control infrastructure and integrated air defense applications, followed by airborne weapons on UAVs or as submunitions, as prioritized by user needs and technical maturity.

EQUIPMENT/FACILITIES

The primary operating location for the Directed Energy Directorate is at Kirtland AFB, NM. Unique facilities include the High Energy Research and Technology Facility, High Energy Microwave Laboratory, High Energy Plasma Laboratory, Starfire Optical Range, Chemical Laser Facility (COIL), and underground tunnels in the Manzano Weapons Storage Area. The Directed Energy Directorate also has two unique sites at remote locations: at the White Sands Missile Range, where there are DE Laser and Optics laboratories sited on cliff edges to permit propagation of laser energy over vast desert valleys; and the Atmospheric Electro-Optical System (AEOS), on top of Mount Haleakala in Maui, HI to permit accurate viewing and tracking of space objects.

Directed Energy Directorate
Kirtland AFB, NM 87117-5776
(505) 846-1911

Director: Dr. R. Earl Good
Deputy Director: Col Douglas Beason

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	2.542	0.147	2.849	5.538
6.2	4.501	9.515	19.725	33.741
6.3	3.798	1.694	45.835	51.327
Subtotal (S&T)	**10.841**	**11.356**	**68.409**	**90.606**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.048	14.613	14.661
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.137	0.055	1.480	1.672
TOTAL RDT&E	**10.978**	**11.459**	**84.502**	**106.939**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	1.609	N/A	0.000	1.609
Other	5.826	N/A	74.410	80.236
TOTAL FUNDING	**18.413**	**11.459**	**158.912**	**188.784**

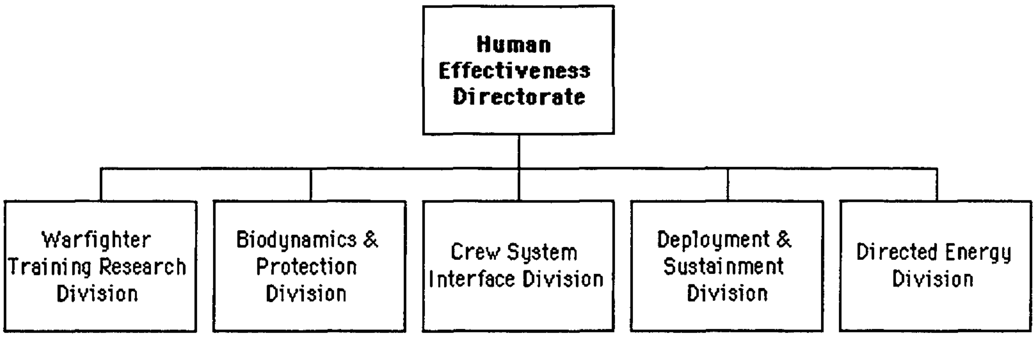
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	18	66	91	175
CIVILIAN	98	92	163	353
TOTAL	**116**	**158**	**254**	**528**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	382.000	**REAL PROPERTY**	92.308
ADMIN	85.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	132.000	**EQUIPMENT**	32.000
TOTAL	**599.000**	* NEW SCIENTIFIC & ENG. EQUIP.	9.600
ACRES	**4325**	* Subset of previous category.	

Human Effectiveness Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Human Effectiveness Directorate
Wright-Patterson AFB, OH 45433-7901
(937) 255-2683

Director: James W. Brinkley
Deputy Director: Col Rocky D. Calcote

MISSION

Develop, integrate, and transition science and technology products for training personnel, protecting and sustaining the crew member, and improving human interface with weapon systems to assure the preeminence of US Air and Space forces.

CURRENT IMPORTANT PROGRAMS

The Human Effectiveness Directorate manages four technology thrusts areas:

Crew System Interface Thrust: The Crew System Interface Thrust conceives, develops, integrates, and transitions science and technology that revolutionizes the human interfaces with weapon systems, to assure the preeminence of US Air and Space forces. This thrust applies the science and technology of biologically based signal processing, cognitive interface design, aural interfaces, noise mitigation, meta interface assessment, human-system interface measurement, bio-centered control and applied multi-sensory interfaces, and visual display interfaces to develop crew system interfaces matched to the warfighter's capabilities. On-going programs are addressing information analysis and exploitation technology, aural displays and bioacoustic technology, crew system development technology, human interface technology, and visual display system technology.

Technology transfer efforts underway include:

- 4 CRADAs - Audio & video display technology (CRADA - Cooperative Research and Development Agreement); 1.5 myrs
- 6 CRADAs - Human interface research; 2.2 myrs
- 1 EPA - Human interface research (EPA - Education Partnership Agreement); .4 myrs

Warfighter Training Thrust: The Warfighter Training Thrust researches, develops, demonstrates, evaluates, and transitions technologies and methods to enable the warfighter to train the way we intend to fight and enable an expeditionary air force. Utilizing the theory and science of learning and instruction, methods for development and evaluation of training, and tools, and technologies for training, this thrust advances the state-of-the-art in training technologies and methods. On-going programs are investigating knowledge representation technologies, distributed mission training technologies, night vision device training technologies, and operation center training methods to create on demand, affordable, realistic training environments.

Current technology transfer efforts include:

- 7 CRADAs - Flight training simulation; 2.6 myrs
- 6 EPAs - Intelligent training systems; 2.2 myrs

CURRENT IMPORTANT PROGRAMS

Bioeffects and Protection Thrust: The Bioeffects and Protection Thrust researches, develops, demonstrates, evaluates, and transitions technology to predict and mitigate the biological effects of aerospace stressors, and directed energy on Department of Defense personnel and mission performance. This thrust defines the human responses to impact, sustained acceleration, vibration, and altitude, and provides human system criteria for emergency escape and crash protection. This thrust also researches the bioeffects of directed energy and the interaction with tissues, organisms, and mammalian function, providing operational guidelines to the warfighter. Current programs are investigating impact protection and safe escape technologies, aircrew protection technologies, laser bioeffects, radio frequency bioeffects, non-lethal technologies, and biomechanisms and modeling methods.

Ongoing technology transfer efforts include:

- 6 CRADAs - Biodynamic protection; 2.2 myrs
- 6 CRADAs - Directed energy bioeffects research; 2.2 myrs

Deployment and Sustainment Thrust: The Deployment and Sustainment Thrust researches, develops, demonstrates, evaluates, and transitions technology to maximize warfighter effectiveness by improving logistics capabilities and assuring survivability in toxic environments. Using logistics systems modeling, enhancement and simulation, advanced information displays, and human performance process models, this thrust enhances the warfighter's capability to deploy and sustain operations. Current programs are addressing readiness and sustainment logistics, predictive toxicology, and chemical and biological defense.

Technology transfer efforts underway include:

- 1 CRADA - Environmental health risk research; .4 myrs
- 2 EPAs - Environmental health risk research; .7 myrs

EQUIPMENT/FACILITIES

The Air Force Research Laboratory Human Effectiveness Directorate conducts Science and Technology Research at Wright-Patterson AFB, OH, Brooks AFB, TX, and Mesa, AZ. Equipment and facilities include: two human centrifuges, a high onset rate centrifuge located at Brooks AFB and a multi-axis centrifuge located at Wright-Patterson AFB; hypobaric chambers with capability to simulate high altitude conditions; anechoic chambers for study of human and noise interactions; biodynamic testing facilities to access human response to abrupt acceleration and impact forces; chronobiology and fatigue countermeasures research facilities; high amplitude noise chambers for study of personnel noise exposure mitigation; six degrees-of-freedom human vibration facility; 3-D whole body scanner for detailed measurement of the human body - used for the development of advanced personal protective equipment, clothing, and crewstation accommodation analysis; the Synthesized Immersion Research Environment (SIRE) - used for development of advanced interface technology for the control of remote assets; "virtual worlds" for systems training research; inhalation toxicology chambers; directed energy

EQUIPMENT/FACILITIES

laboratory to research bioeffects of lasers and Radio Frequency radiation; human isolation facility for controlled study of group dynamics in simulated air operations; secure facility capable of processing and networking multiple levels of sensitive information.

Human Effectiveness Directorate
Wright-Patterson AFB, OH 45433-7901
(937) 255-2683

Director: James W. Brinkley
Deputy Director: Col Rocky D. Calcote

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	1.545	0.000	4.450	5.995
6.2	20.986	3.925	29.175	54.086
6.3	3.681	2.305	30.248	36.234
Subtotal (S&T)	**26.212**	**6.230**	**63.873**	**96.315**
6.4	0.079	0.000	0.133	0.212
6.5	0.000	0.000	16.010	16.010
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.724	0.000	2.487	3.211
TOTAL RDT&E	**27.015**	**6.230**	**82.503**	**115.748**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.335	0.335
Other	4.021	N/A	28.237	32.258
TOTAL FUNDING	**31.036**	**6.230**	**111.075**	**148.341**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	19	72	104	195
CIVILIAN	77	100	145	322
TOTAL	**96**	**172**	**249**	**517**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	287.062	**REAL PROPERTY**	498.190
ADMIN	214.009	* NEW CAPITAL EQUIPMENT	2.253
OTHER	126.069	**EQUIPMENT**	62.743
TOTAL	**627.140**	* NEW SCIENTIFIC & ENG. EQUIP.	2.767
ACRES	**118**	* Subset of previous category.	

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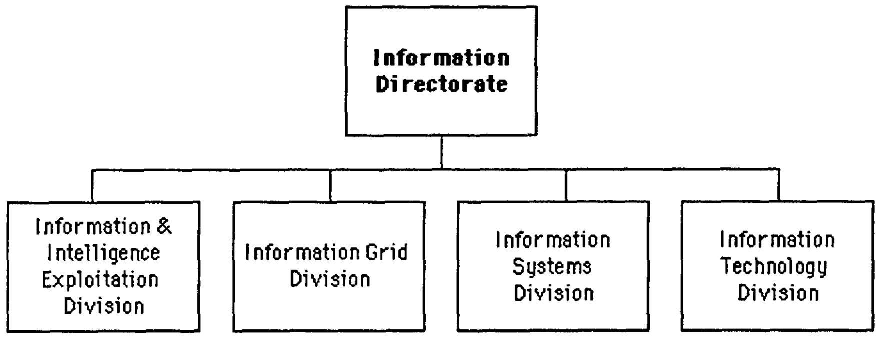
Information Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Information Directorate
Rome, NY 13441-4514
(315) 330-7701

Director: Mr. Raymond Urtz
Deputy Director: Col John Bedford

MISSION

The advancement and application of Information Systems Science and Technology to meet Air Force unique requirements for Information Dominance and its transition to aerospace systems to meet Air Force needs.

The Directorates areas of investigation include a broad spectrum of information and fusion, communication, collaborative environment and modeling and simulation, defensive information warfare, and intelligent information systems technologies.

CURRENT IMPORTANT PROGRAMS

GLOBAL AWARENESS: DoDIIS Information System Infrastructure; Broadsword; ISSE Guard Information Support Server Environment; Trusted Transfer Agent; Coalition Architecture; Cognitive Desktop Information Manager; Distributed Analysis and Decision Support System; Intermediate Text Exploitation; Enhanced IPB; Joint Targeting Toolbox; Ground Moving Target Indicator Exploitation Tools; Adaptive Sensor Fusion; Hyperspectral Information Exploitation Tools; Hyperspectral Information Fusion; Exploitation Toolkit for Video; Image Data Imbedding for Information Augmentation; Image Information Hiding for Coalition Ops; Speech/Audio Processing; Intelligent Agents; High Performance Knowledge Bases.

DYNAMIC PLANNING & EXECUTION: Joint Battlespace Infosphere; Effects Based Aerospace Operations; Dynamic Data Base; Joint Defensive Planner; Joint Environment Exploitation Segment; Integrated C2 Resource Controller & Master Caution Panel; Portable Interactive Data Wall; JFACC Radar Scope.

GLOBAL INFORMATION EXCHANGE: Multi-Domain Network Management; Air Force Comprehensive Enterprise Management; Air Force Enterprise Defense; Airborne Comm Node; Information for Global Reach; High Capacity Information Connectivity for Aerospace; Future Air Navigation Traffic Avoidance Solution Through Integrated CNS; Adaptive Computing; Micro-Electro Mechanical Systems.

TECHNOLOGY TRANSFER: The technology area of Information Assurance (IA) is of utmost importance to the Air Force and to the private sector. AFRL/IF continued its on-going Cooperative Research Development Agreement (CRADA) in this area with the Odessey Research Associates Computer Forensics Research and Development Center associated with Syracuse University. This research will exchange information at AFRL/IF and the collaborator's facilities leading to the development of new candidate tools in the area of computer forensics to address countermeasures for computer-related crime for the law enforcement community on the federal, state, and local levels. These same tools could be incorporated in the AF Defensive Information Warfare R&D being performed at

CURRENT IMPORTANT PROGRAMS

AFRL/IF. In addition, IF proactively teamed with Cornell University under the IF Information Institute Education Partnership for the creation of the Cornell & AFRL/IF Information Assurance Institute.

In FY00 there were 12 Cooperative Research Development Agreements, 13 Educational Partnership Agreements, 3 Patent License Agreements started and 6 patents issued to the Directorate.

EQUIPMENT/FACILITIES

Primary operation locations are: Griffiss Business & Technology Park, Rome NY and Wright-Patterson Air Force Base, Dayton OH. Equipment and facilities include:

Equipment: SKY - High performance computer - fastest in the Air Force with 384 processors capable of system throughput of 597 GFLOPS.

Facilities: Defensive Information Warfare Facility - only systems level facility addressing complete Information Assurance and operations issues; Fusion Facility - multi-sensor information fusion; Ground Moving Target Indicator Exploitation Center of Excellence - premiere facility in the world that develops, evaluates and transitions advanced GMTI trackers & dissemination technology and fusion exploitation & architectures; Satellite Communications Testbed - a specialized C-135 aircraft that provides an airborne testbed for propagation phenomena; Signal Processing Facility; Network Management R&D Facility - measurement of UHF and VHF radio transmitter and receiver performance parameters; High Performance Computing Facility - SKY and Paragon high performance computers; Command & Control Visualization Facility; Distributed Systems Evaluation Environment Testbed; Imagery Exploitation 2000/Elint Facility - capable of coupling new R&D technology and commercial hardware and software with operational systems; Command & Control Technology Center - consists of controlled access computing environment with state-of-the-art processing and display equipment; Computer Science & Technology Facility - integrates and prototypes next generation Knowledge Based Planning & Decision Aid tools; Systems Demonstration Evaluation Facility - measurement and analysis of multibeam antennas and jammer-nulling characteristics; Newport and Stockbridge antenna Evaluation Facilities - two hilltops 1.5 miles apart with six fully instrumented far-field reflectivity ranges; Concealed Weapons Detection Facility - specialized analysis and demonstration of detection through-the-wall technologies; Joint Reserve Intelligence Facility provides fully operational NIPRNET, SIPRNET and JWICS real-world Intel results.

Information Directorate
Rome, NY 13441-4514
(315) 330-7701

Director: Mr. Raymond Urtz
Deputy Director: Col John Bedford

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.586	0.591	1.991	3.168
6.2	40.585	7.900	154.429	202.914
6.3	7.791	7.849	138.954	154.594
Subtotal (S&T)	**48.962**	**16.340**	**295.374**	**360.676**
6.4	3.646	3.524	21.535	28.705
6.5	2.264	2.344	17.320	21.928
6.6	0.159	0.165	2.235	2.559
6.7	0.912	0.874	16.790	18.576
Non-DOD	0.169	0.176	2.882	3.227
TOTAL RDT&E	**56.112**	**23.423**	**356.136**	**435.671**
Procurement	0.639	N/A	0.884	1.523
Operations & Maintenance	12.904	N/A	83.880	96.784
Other	5.554	N/A	0.000	5.554
TOTAL FUNDING	**75.209**	**23.423**	**440.900**	**539.532**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

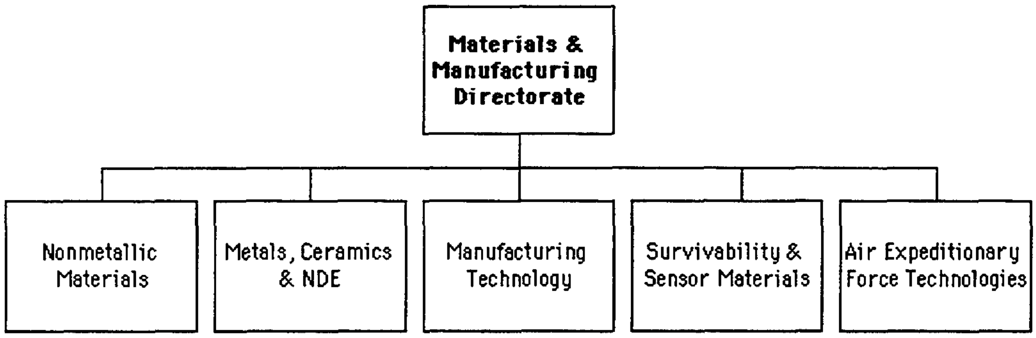
PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	3	49	43	95
CIVILIAN	30	309	401	740*
TOTAL	**33**	**358**	**444**	**835**

** The Total Civilian Personnel number includes 66 students that are maintained on our personnel roles.*

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1065.400	**REAL PROPERTY**	54.500
ADMIN	89.200	* NEW CAPITAL EQUIPMENT	0.000
OTHER	220.300	**EQUIPMENT**	83.500
TOTAL	**1374.900**	* NEW SCIENTIFIC & ENG. EQUIP.	5.800
ACRES	**84**	* Subset of previous category.	

Materials Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Materials Directorate
Wright-Patterson AFB, OH 45433-7739
(937) 255-4726

Director: Dr. Charles E. Browning
Deputy Director: Col Timothy J. Brotherton

MISSION

Plan and execute the USAF program for materials and manufacturing in the areas of basic research, exploratory development, advanced development and industrial preparedness. Provide responsive support to Air Force product centers, logistics centers, and operating commands to solve system and deployment related problems and to transfer expertise.

Aerospace materials and manufacturing leadership for the Air Force and the nation.

CURRENT IMPORTANT PROGRAMS

Metallic Materials Computational Methods and Tools encompasses research and development leading to effective modeling and simulation for advanced metals development, processing, and behavior and life prediction. This modeling and simulation technology is critical to accelerating the development and implementation of new metals technologies and to dramatically reducing development costs.

The Metals Affordability Initiative is a unique consortium of domestic metal suppliers focused on impacting affordable metals technologies and associated business case development and transition plans to lower acquisition costs of metallic components and assemblies by 50%.

Dimensional Control of Large Composite Structures is investigating process modeling and material variability effects on final dimensions of composite structures. This will eliminate cost intensive processing steps and improve the ability to predict behavior and tolerance variability for composite parts, reducing cost and improving performance of composite structures.

Thermal Management Materials program is developing alternative highly conductive material systems to replace aluminum and inconel environmental control system heat exchangers with lightweight, high thermal conductivity, corrosion resistant composite materials. Replacement with composites improves sustainability, reduces weight and increases range of air platforms.

Composite Affordability Initiative develops the tools and technologies necessary to enable integrated product teams to confidently design, manufacture and integrate with aircraft subsystems and (all-composites) airframe utilizing revolutionary design techniques, innovative manufacturing concepts, materials, processes and advanced business practices, to enable breakthrough reductions in cost, schedule and weight.

Developing Innovative Non-destructive Evaluation technologies being developed include eddy current methods and laser-based ultrasound techniques to detect hidden corrosion on aging aircraft. These techniques play a significant role in the effective management of the safety and cost of the aging AF fleet.

CURRENT IMPORTANT PROGRAMS

The Point Inspection LO Tool program is developing RF imaging tools and IR reflectometer tools to allow inspection of low observable systems during deployed operations. This technology greatly enhances the affordability and maintainability of the LO fleet and supports survivability, readiness, and Air Expeditionary Force operations as well.

The Non-destructive Evaluation for Turbine Engines effort investigates the integration of several NDE techniques to conduct residual stress gradient measurements to better predict remaining life of engine components, allowing retirement for cause and extended life of engine components. Enables significant cost avoidance for management of aging AF fleet.

Gap Treatments for Low Observable Aircraft develops electronically conductive gap sealants for stealth aircraft. This technology dramatically reduces the maintenance man-hours per flight hour while preserving integrity of low observable system and enhancing survivability and operability of the low observable fleet.

The Infrared Reduction Coatings program is scaling up and transitioning infrared signature reduction coatings for advanced aircraft to enhance their survivability in infrared threat environments.

Detector Materials and Materials Processes investigates and develops materials and processes to improve the yield of low rate production detector materials to reduce cost of focal plane arrays for space based infrared sensor applications. This program also develops multi and hyperspectral detector materials to enable multiple sensors on a single focal plane, dramatically reducing the weight and cost of sensor systems.

The Non-linear Optical Materials effort develops non-linear optical materials and processes to enable laser line frequency conversion of low cost, lightweight, solid state laser sources. This technology is key to enabling affordable infrared countermeasure systems for large aircraft protection against anti-aircraft missiles.

Laser Hardened Concepts program invents and investigates advanced laser protection concepts and materials for high-speed, broadband response. The technology developed on this program will provide the basis for fabricating novel tunable filters and optical limiters for wavelength independent protection of personnel and electro-optical sensor systems.

Force Protection Research program is developing and demonstrating elastomeric coatings and retrofit techniques to harden and protect deployed soft assets against terrorist and other unfriendly threats. This technology enhances the safety of deployed troops and equipment in forward deployed operations and locations and supports the implementation of the expeditionary Air Force concept.

Mixed Based Hydrogen Peroxide research and development program is developing an industrial based process to make mixed base hydrogen peroxide for use as the laser energy source on the Airborne Laser system. This technology is a critical enabling technology for the baseline ABL.

Electronics Parts Obsolescence program is a major initiative to address the problem of managing the Air Force fleet with many parts out of or going out of production. This is an issue for aging, fielded, and soon to be fielded systems. Successful implementation of process and management methods is critical to managing the safety and cost of sustaining the AF fleet.

CURRENT IMPORTANT PROGRAMS

The Management of Affordable Space Systems program focuses on implementation of new technologies and lean principles to manage the cost of AF space systems. The program is focused on satellite systems to complement the AF investment in launch cost reduction.

Supplier Focused Initiatives aim to fuse new technologies and lean principles and implement these ideas into small/medium based suppliers, casting suppliers, and forging suppliers. Successful transfer of these concepts will result in significant cost reductions for deploying future AF systems and sustaining the deployed and aging fleet.

EQUIPMENT/FACILITIES

Behavior and Life Prediction Laboratory - Extensive and unique capability for evaluation of properties of metals, alloys, and composites under a wide range of environmental conditions, including high cycle fatigue.

Laser Hardened Materials Evaluation Laboratory - Unique capability to evaluate laser/materials interactions and effects of lasers on advanced materials for aerospace applications. Includes a 150 KW, continuous wave, carbon dioxide laser with a well characterized flat-top beam and 1 to 11 cm spot sizes Special capabilities include three vacuum environment test chambers (1x10-6 Torr); 50 ksi tensile test machine; subsonic blow-down wind tunnel (Mach 0.1 to 0.9); supersonic blow-down wind tunnel (Mach 2); 7ft by 9 ft chamber (to lx10-6 Torr); cryogenic sample holders.

Electronic Properties of Semiconductors Laboratory - In this unique facility, one can measure the Hall Effect at ambient and elevated temperatures, the temperature-dependent Hall Effect, and the Shubnikov Effect. In addition, there is the capability for doing deep level transient spectroscopy and optical admittance spectroscopy.

Processing Laboratory - This is a unique facility for the processing of a wide range of metals and alloys. It includes both commercial and one-of-a-kind apparatus for producing special samples by extrusion, forging, rolling, swaging, and heat-treating.

SCEPTRE Laboratory - The Space Coatings Environmental Test and Research Laboratory is a unique facility for testing thermal radiation and protective coatings under conditions of high vacuum, high electron or proton flux, and high intensity electromagnetic radiation Computational Materials.

Molecular Modeling Laboratory - A variety of workstations and software, plus a virtual reality facility with a force-feedback arm.

Chemical Analysis Laboratory - Includes capability for the wet chemical and instrumental analyses of a wide range of materials.

NDE Laboratory - Facilities for the non-destructive evaluation of metallic and non-metallic materials.

EQUIPMENT/FACILITIES

Failure Analysis Laboratory - Capability for the analysis of metal, electronic, and other samples for purposes of determining the causes of failure.

Corrosion Test Laboratory - Facilities comprise a variety of equipment for testing, and instruments for evaluating corrosion.

Rain Erosion Facility - This unique facility permits the evaluation of rain erosion of a variety of materials under realistic use conditions.

Ultrasonic Laboratory - Ultra-high frequency laser-generated ultrasound system, acoustic microscopes and large and small precision ultrasonic imaging systems.

Computed Tomography (CT) Laboratory - Includes a laminography/dual energy CT system and a tomoscope CT system.

Polymer Physics Experimental Laboratory - Includes instrumentation necessary to measure thickness and the conductivity of polymer films.

Polymer Characterization Laboratory - This laboratory includes the capability for obtaining spectroscopic data, plus measuring the mechanical and thermal properties of polymers.

Fiber/Film Fabrication Laboratory - This laboratory provides the capability for producing fibers and films in controlled environments.

Polymer Synthesis Laboratory - A well-equipped facility for the synthesis and chromatographic characterization of polymers.

Morphology Laboratory - An X-ray diffraction laboratory with multiple generators and cameras, plus optical and electron microscopes.

Analytical Spectroscopy Laboratory - This laboratory includes FTIR, Solid State NMR, and GC-MS, with all supporting equipment.

Optical Microscopy Laboratory - In this laboratory there are a variety of light microscopes and an electron microscope.

Thermal Analysis Laboratory - This well-equipped laboratory is equipped to do DSC, PDSC, DTA, TGA and Dilatometry measurements.

Rheological Characterization Laboratory - This laboratory is centered around a Dynamic Mechanical Analyzer.

Mechanical Characterization Laboratory - This well-equipped laboratory features tensile and other mechanical tests for laboratory to extremely large scale samples.

Materials Processing Laboratory - Enables formulation of resins and the assembly and processing of a variety of composite materials.

EQUIPMENT/FACILITIES

Optical Properties of Semiconductors Laboratory - A wide variety of measurements are possible in this laboratory, including infrared, photoluminescence, light scattering, reflectance, and magneto-optical semiconductor behavior.

Nonlinear Optical Materials Laboratory - In this laboratory, one can measure a variety of NLO properties on bulk and film samples.

Superconductor Materials Characterization Laboratory - This laboratory has the capability to measure transport properties and critical current densities along with AC magnetic susceptibility.

Pulsed Laser Deposition Laboratory - The capability exists to prepare thin films for hard or lubricious coatings or for application in sensors.

Molecular Beam Epitaxy Laboratory - This is a major facility for the preparation and characterization of a wide range of semiconductor materials and devices.

AC Hydraulic Pump Test Laboratory - This is a specialized facility for testing both components of aircraft hydraulic systems and hydraulic fluids.

Lubricant Traction Lab - This laboratory is a specialized facility for measuring the traction coefficients of liquid lubricants under controlled (high) temperature conditions.

Optical Lab - Included in this laboratory is a variety of optical instrumentation including scatterometers, emissometers, imaging IR radiometers, UV-Vis-NIR and IR spectrophotometers, and optical microscopes.

Liquid Lubricants Lab - This laboratory includes a wide range of testing equipment such as viscosity baths and measuring devices and instruments such as gas chromatographs, a gas chromatograph-mass spectrometer, and an infrared spectrophotometer.

X-ray Photoelectron Spectroscopy Laboratory - In this laboratory there are two XPS instruments, one devoted to solid lubricants and a second with an in-situ tribometer for use with solid or liquid lubricants.

Raman Analysis Laboratory - There are two Raman spectrometers in this lab, primarily used for the evaluation of solid lubricant coatings.

Mechanical Test Laboratory - This laboratory comprises a variety of instruments for determining friction and wear properties of lubricant, hard coatings, and other systems.

Ceramic Composites Research Laboratory - This laboratory has a wide variety of specialized equipment for fiber growth and coating, ceramic powder characterization and composite processing and testing.

Materials Directorate
Wright-Patterson AFB, OH 45433-7739
(937) 255-4726

Director: Dr. Charles E. Browning
Deputy Director: Col Timothy J. Brotherton

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	9.471	0.000	0.000	9.471
6.2	21.779	30.157	21.142	73.078
6.3	0.000	5.119	25.672	30.791
Subtotal (S&T)	**31.250**	**35.276**	**46.814**	**113.340**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	21.723	21.723
6.6	0.000	0.000	0.000	0.000
6.7	0.000	13.658	33.149	46.807
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**31.250**	**48.934**	**101.686**	**181.870**
Procurement	0.000	N/A	2.972	2.972
Operations & Maintenance	0.000	N/A	9.412	9.412
Other	13.215	N/A	33.981	47.196
TOTAL FUNDING	**44.465**	**48.934**	**148.051**	**241.450**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	4	42	12	58
CIVILIAN	89	244	110	443
TOTAL	**93**	**286**	**122**	**501**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	294.500	**REAL PROPERTY**	103.800
ADMIN	189.300	* NEW CAPITAL EQUIPMENT	0.080
OTHER	83.400	**EQUIPMENT**	43.800
TOTAL	**567.200**	* NEW SCIENTIFIC & ENG. EQUIP.	0.100
ACRES	**135**	* Subset of previous category.	

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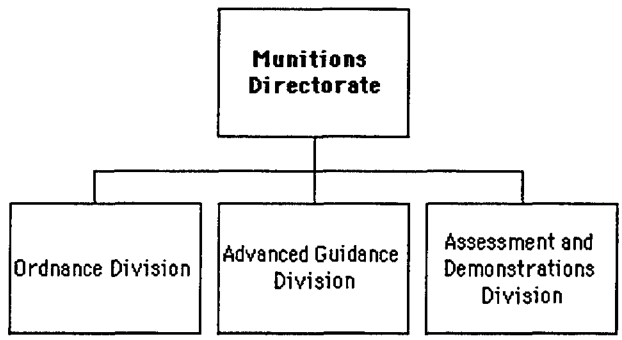
Munitions Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Munitions Directorate
Eglin AFB, FL 32542-6810
(850) 882-3003

Director: Col. Thomas J. Masiello
Associate Director: Mr. Stephen. C. Korn

MISSION

Develop, integrate, and transition science and technology for air-launched munitions for defeating ground fixed, mobile/re-locatable, air and space targets to assure the preeminence of U.S. air and space forces.

CURRENT IMPORTANT PROGRAMS

MN's research and development planning process is structured around Integrating Concepts. The Integrating Concepts can be thought of as planning modules consisting of suites of technologies integrated into munition systems, time phased over a 25-year period into near, mid- and far-term concepts. Each of the Integrating Concepts has been built around satisfying particular warfighters' needs associated with engaging air and ground targets. The Integrating Concepts are implemented via Integrated Product Teams drawn from the Directorate's Core Competencies and from external organizations to develop the necessary technology roadmaps and concepts. An annual process is conducted to ensure the Integrating Concepts remain fully aligned with the users' operational needs and to capture new technology opportunities. The Directorate has currently identified four near-term Integrating Concepts: Small Smart Bomb, Anti-Materiel Muntion, Hard Target Smart Munition and Air Superiority Missile. The Directorate is also initiating four mid/far-term Integrating Concepts: Air Expeditionary Forces Munition, Close Air Support/Urban Combat Munition, Hard Target Functional Defeat, and Counter Proliferation Munition as depicted below.

The Small Smart Bomb (SSB) Integrating Concept (ICIPT) is developing the set of synergistic technologies to allow miniature munitions to defeat 85% of the MK-83/BLU-109 target set. This target set consists of fixed soft to moderately hardened targets as well as relocatable targets. There are many benefits to smaller munitions, the greatest of which is an increased loadout capability for fighter and bomber aircraft. Miniature munitions also permit usable payloads to be carried in small delivery platforms such as Uninhabited Combat Air Vehicle (UCAV) and the planned Common Air Vehicle (CAV).

The Anti-Materiel Munition (AMM) Integrating Concept Integrated Product Team (ICIPT) pulling together four new techniques that will revolutionize air-to-surface warfare against ground mobile targets. Our targets are the enemy vehicles that bring the war to us and include SCUDs, surface-to-air missiles (SAM), and tanks. The new technologies include a 3-dimensional imaging laser radar (LADAR) Seeker and a multi-mode warhead (capable of shooting tank targets with explosively formed slugs and softer SCUD and SAM missile launchers with a shotgun spray of lethal fragments).

The Hard Target Smart Munition (HTSM) Integrating Concept (ICIPT) follows the vision of providing the warfighter with the means to hold all of an enemy's hardened and/or deeply buried structures at risk using conventional, air-delivered munitions. Its task is to advocate, initiate, develop, and transition the munition related technologies necessary to accomplish this vision.

The Air Superiority Missile (ASM) Integrating Concept (ICIPT) is focused on the technical challenges of defeating broad classes of airborne targets as well as a limited set of ground based enemy

CURRENT IMPORTANT PROGRAMS

air defense targets. The Air Superiority technology planning process consists of four distinct sub-processes designed to provide technology solutions for both current and future postulated air combat operational needs.

The Air Expeditionary Forces (AEF) Munitions Integrating Concept is developing the set of technologies to rapidly degrade enemy warfighting capability without manned over-flight. By combining long-range standoff and low logistics footprints, these concepts will expand the warfighters capability to rapidly respond to any region of conflict.

The Close Air Support (CAS) Integrating Concept Integrated Product Team will pull together new technologies for Joint Strike Fighters (JSF) and legacy aircraft to attack ground mobile targets in close proximity to friendly forces. CAS targets include fixed and mobile, precisely and non precisely located targets (e.g., Tanks, APCs, SCUD, SEAD, Pill Boxes, Snipers, etc.).

The Hard Target Functional Defeat (HTFD) Integrating Concept is developing technology to provide the warfighter with the means to deny, disrupt, disable, destroy, or gather intelligence on the enemy hard and/or deeply buried targets using innovative kill mechanisms, air delivered systems.

The Counterproliferation (CP) Integrating Concept Team works toward the ultimate goal of providing a weapon that can defeat all targets containing chemical and biological agents without negatively impacting any surrounding civilian populus. This effort is challenging because of the broad target spectrum and the breath of agents.

The Munitions Directorate (MN) of the Air Force Research Laboratory has instituted a full spectrum technology transfer program consisting of outreach, education, patents and intellectual property management, marketing, and cooperative research efforts. At the present time, the Munitions Directorate has seven active Cooperative Research and Development Agreements (CRADAs). These CRADAs encompass research in multi-sensor modeling and analysis, shaped explosives, millimeter wave/radar imaging, booster-to-main charge detonation transfer for warhead design, infrared imaging polarimeter technologies, joint research and testing capabilities in the Aeroballistic Research Facility, and miniature munition separation. One example of this cooperative research is a CRADA with Halliburton Energy Services, Inc., to provide professional and technical resources to conduct the research, development, and testing of explosive cutter devices to mature the technology for commercial and military application. The Munitions Directorate and Halliburton will analyze and evaluate the explosive cutter devices to determine their application to advance munitions and commercial oil field service products.

Four University professors worked in AFRL/MN in FY00 under Intergovernmental Personnel Agreements (IPA).

EQUIPMENT/FACILITIES

Primary Operating location is Eglin AFB FL. Equipment and Facilities include:

- **Munitions** research complex which includes the following labs:
  - **Kinetic Kill Hardware in the Loop Simulation (KHILS):** Provides an independent, government owned, national resource for nondestructive testing and technology integration of

EQUIPMENT/FACILITIES

precision guided weapon systems.

- **Inertial Navigation Lab:** Develops and conducts experiments on tactical grade weapons navigation and control technology.
- **Optical Correlation Research Lab:** Designs, develops and evaluates optical processors for munition applications, combines lenses, mirrors and laser diodes to process data at the speed of light.
- **Environmental Sciences Lab:** Supports conventional munitions technology programs and environmental assessment requirements through chemical, radiochemical and microanalysis research.
- **Prototype Munitions Fabrication Lab:** Provides a wide range of rapid fabrication support for experimental hardware for testing in exploratory and advanced development programs.
- **Technical Library:** Provides technical library support for the Munitions Directorate and the Air Armament Center.
- **Radio Frequency/Millimeter Wave Lab:** Develops and evaluates sensors and seekers using radar guidance technology employing frequencies up to millimeter wave.
- **Advanced Guidance Research Lab:** Provides image and signal processing computer lab for developing and evaluating weapon guidance algorithms.

- **High Explosive Research & Development Facility:** Provides high explosive formulation, processing, x-ray, quality control and loading support for Air Force non-nuclear weapons development programs.
- **Advanced Warhead Experimentation facility:** Provides state-of-the-art capability to conduct research and development of advanced warhead technologies; including heavy metals, projectiles, penetrators, shaped charge liners, agent defeat payloads, electromagnetic payloads, and various initiation components and explosives.
- **Fuze Research and Development Facility:** Provides capability to develop and evaluate technologies for fuzes, target detection devices, and initiation components of conventional air launched fuzes. Simulates shock and G loading needed to develop penetration fuzing.
- **LADAR Development and Evaluation Research Facility:** Develops and evaluates active imaging direct detection laser radar seekers.
- **Aeroballistic Research facility:** Advances basic aerodynamic knowledge and defines aerodynamic performance, stability and control parameters for advanced ammunition and high fineness ration penetrators. Only range suited for medium caliber free flight experimentation and testing to acquire dynamic stability derivatives for spin stabilized ammunition.

Munitions Directorate
Eglin AFB, FL 32542-6810
(850) 882-3003

Director: Col. Thomas J. Masiello
Associate Director: Mr. Stephen. C. Korn

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	0.445	N/A	N/A	0.445
6.1 Other	1.149	0.000	0.000	1.149
6.2	14.766	3.349	16.922	35.037
6.3	0.000	2.314	16.639	18.953
Subtotal (S&T)	**16.360**	**5.663**	**33.561**	**55.584**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	14.384	14.384
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**16.360**	**5.663**	**47.945**	**69.968**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	3.394	N/A	38.960	42.354
TOTAL FUNDING	**19.754**	**5.663**	**86.905**	**112.322**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
TYPE	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	END STRENGTH
	DOCTORATES	OTHER		
MILITARY	5	41	17	63
CIVILIAN	36	140	75	251
TOTAL	**41**	**181**	**92**	**314**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	202.825	**REAL PROPERTY**	22.644
ADMIN	19.103	* NEW CAPITAL EQUIPMENT	0.000
OTHER	43.253	**EQUIPMENT**	35.864
TOTAL	**265.181**	* NEW SCIENTIFIC & ENG. EQUIP.	1.875
ACRES	**1159**	* Subset of previous category.	

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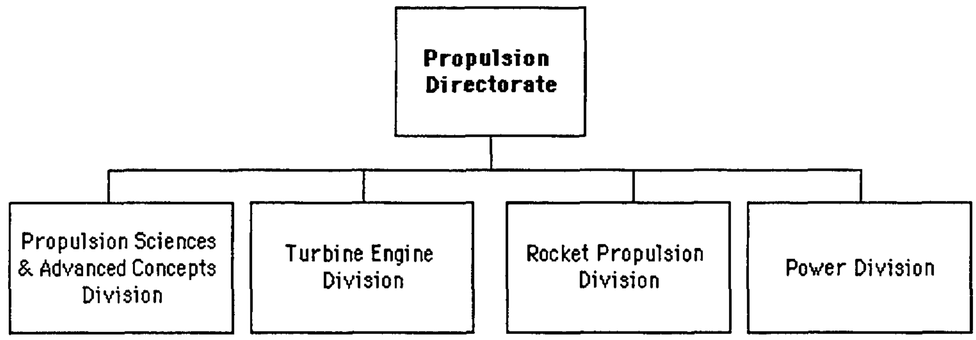
Propulsion Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Propulsion Directorate
Wright-Patterson AFB, OH 45433-7251
(937) 255-2520

Director: Col. Alan M. Janiszewski
Deputy Director: Fred W. Oliver

MISSION

AFRL/PR creates and transitions propulsion and power technology for the military dominance of air and space.

CURRENT IMPORTANT PROGRAMS

FY00 Integrated High Performance Turbine Engine Technology (IHPTET): Joint DoD/NASA/Industry time-phased program to demonstrate technologies to enable doubling turbine engine capability by 2003. IHPTET includes three classes of engines: large turbofan/turbojet for fighters, bombers, and transports; smaller turboprop/turboshaft for rotorcraft, patrol, and trainers; and limited life for missiles and UAVs.

Integrated High Payoff Rocket Propulsion Technology (IHPRPT): Joint DoD/NASA/Industry program to demonstrate rocket propulsion technologies to improve performance of solid and liquid rockets. IHPRPT includes all classes of rockets including tactical, space launch, and orbit transfer.

Aerospace Power: A three thrust program that develops and demonstrates electrical power system technologies for aircraft, directed energy weapons (DEW), and space systems applications. Research is conducted in power generation, power management and distribution, thermal management, and energy storage system technologies for all three applications. The joint More Electric Aircraft (MEA) program is focused on improving aircraft performance, reliability, and maintainability. The space power program is developing enabling power system technologies for advanced space system concepts. The weapons power program is developing the power system technologies that will enable high power airborne DEW applications.

Hypersonic Technology for Missiles (HyTech): HyTech develops and demonstrates hypersonic technologies for advanced airbreathing propulsion systems. The current emphasis is on a Mach 4-8 hydrocarbon-fueled scramjet for unmanned (missile) application. Long-term applications include hypersonic strike/ reconnaissance vehicles and affordable on-demand space access.

JP-8+225 Fuel Development Program: This program seeks to develop a second generation high heat sink fuel thermally stable to 550°F, JP-8+225. JP-8+225 will build on the additive technology of JP-8+100 and will require a more aggressive additive package that eliminates autoxidation deposits and enables the continuous use of the fuel as a cooling media in high performance aircraft.

TECHNOLOGY TRANSFER

The Propulsion Directorate has CRADAs to conduct impact and containment testing of GE90 (which is a commercial engine) turbine blade; to investigate carbon lithium-ion battery anodes; and to investigate the use of drag-reducing agents in pipelines to increase throughput; to develop commercial

CURRENT IMPORTANT PROGRAMS

applications of Polyhedral Oligomeric Silsesquioxane (POSS); to develop an improved field-deployable, environmentally-friendly environmental control unit; to investigate and characterize monopropellants and monopropellant thruster technology; to commercialize a fuel additive to increase thermal stability and decrease maintenance associated with coking; to conduct testing and evaluation for two Pulse Detonation Engine configurations.

EQUIPMENT/FACILITIES

Compressor Aero Research Lab - The CARL is used to perform independent Air Force basic and applied research in compressor aero-performance through investigations into high risk/high payoff turbine engine axial compressor aeromechanical performance.

Compressor Research Facility - The CRF conducts and supports exploratory and advanced development efforts in compressor technology, independently evaluating full-scale, multi-stage, single-spool dual-flow fans and compressors under operating conditions similar to an actual flight profile.

Turbine Engine Fatigue Facility - Used to perform structural and vibrational evaluations on turbine engine components, demonstrate durability of advanced turbine engine components, and perform life predictions and analytical assessments.

Turbine Aero Thermal Basic Research Facility - Used to determine boundary conditions for computations, including turbulence intensity levels and scales along with heat transfer measurements, to evaluate turbulence models, design methods and heat transfer mechanisms for turbine engines.

Turbine Research Facility - Used for exploratory development of advanced, full-scale turbines, studies include aerodynamic, aerothermal and aeroelastic research. The facility simulates all important engine conditions through the use of aero and thermodynamic similarity in a short-duration (transient) research procedure.

Component Calibration Facility - Used to support all the above turbine engine research facilities. This facility is used for the development of advanced, experimental instrumentation, such as laser transit anemometry and laser Doppler anemometry systems that are used to measure intra-blade flow fields.

Scramjet Research Facility - Used to perform research of high risk/high payoff scramjet engine combustion devices in the Mach 3-8 range. Operating parameters can simulate conditions from 0 to 100,000-ft altitude and Mach 2 to 6. These conditions can be sustained indefinitely making use of the 30 1bm/s continuous flow capacity of the Directorate's Air Facility.

Ramjet Combustion Research Facility - Used to conduct fundamental and applied research for subsonic combustion ramjet component research and development in the Mach 2-5 range. It consists of a small-scale, direct-connect thrust stand (component size up to 12-inch diameter, 60-inch length) with vitiated air heater and 0_2 replenishment system.

Supersonic Research Facility - A continuous flow supersonic combustion tunnel, which is specifically designed for optical diagnostics of supersonic fuel and air mixing combustion. The facility is housed in

EQUIPMENT/FACILITIES

a climatically controlled explosion proof laboratory to allow research with hydrocarbon and hydrogen fuels. The principle program in this facility is the measurement of turbulent mixing of fuel and air stream in supersonic flow regimes.

Fuel Development Research Facilities - State-of-the-art, nationally unique facilities using a wide variety of instrumentation and equipment to develop, analyze, characterize, and process aviation and missile fuels and fuel additives for all current, next generation and future AF air breathing weapon systems. Fuel storage facilities are also available for evaluation of long-term storage effects at controlled conditions.

Turbine Engine Lubricants Research Facilities - Used to perform RDT&E to develop optimum lubricants and provide timely and effective lubricant-related operational support to satisfy current and future Air Force and DoD gas turbine engine needs. Part of the effort in this facility includes running full-scale engine operations to qualify oils for the field and to maintain and upgrade military specifications for use in procuring oils.

Bearings Research Facilities - Used to study the basic mechanisms involved in lubrication of bearing surface, and to establish a technical database for design of conventional and alternative lubrication concepts for advanced turbine engines.

Diagnostic Development and Combustion Research Facilities - Used to conduct basic research in combustion sciences, conduct exploratory development of combustor concepts, and to develop combustion models and diagnostic techniques.

Component Research Air Facility - The Air Facility is used to provide simulated flight conditions for R&D programs in the turbine engine advanced propulsion and fuel technology areas. It supports the six component research cells in Bldg 18C and 18E, as well as the Compressor Research Facility.

Propeller Test Facilities - Three electrically driven whirl test stands are used to determine propeller (or other rotating device) performance at various rotational speeds. These test stands are capable of performance and endurance testing of propellers to 10,000 horsepower and 10,800 rpm.

Helicopter Rotor Facility - This electrically driven whirl test stand is used to determine rotor performance at various rotational speeds. This facility is capable of performance and endurance testing of up to 90-ft diameter rotors to 6,000 horsepower and 625 rpm. Horsepower and lift can be determined for various speeds. (This facility has been mothballed.)

High Power Laboratory - This laboratory supports the development of materials, components and systems for application in the presence of very high electric fields or currents in electrical systems for various Air Force and DoD missions.

Battery Laboratories - This facility is equipped to conduct research and development in the area of electrochemical power generation, evaluate advanced battery and fuel cell designs, and conduct experiments and analyses to support electrochemical power sources.

Power Devices, Components & Power Systems Facilities - Used to evaluate the electrical performance characteristics of experimental power semiconductor devices, evaluate experimental

EQUIPMENT/FACILITIES

optically controlled power devices, and to conduct supporting power semiconductor materials research for air and space vehicles and directed energy weapons systems.

Heat Transfer R&D Facilities - Utilized to conduct basic and applied heat transfer research applicable to power system thermal management in existing and advanced aircraft, as well as some spacecraft applications. Overall, the laboratory supports research in heat pipe performance and life cycle, thermal energy storage, and advanced experiments related to pulse power.

Sea Level Engine Facility - To conduct R&D on full-scale turbine engines, systems and sub-systems under sea level atmospheric conditions. The main cell was converted for use as for Pulse Detonation Engine reaearch. Other support equipment/systems are used by activities in other Turbine Engine Research Complex facilities.

Superconductivity Laboratory - This laboratory provides a complete facility for the development, production, and measurement of high temperature superconductors for high power applications.

Plasma Physics Research Facilities - The Plasma Physics Laboratory pursues basic experimental and theoretical research on plasmas having applications to laser, high power switches, plasma diagnostics, power generation, combustion diagnostics, high energy density fuel storage, and plasma processing of thin films.

Advanced Launched System Complex (Area 1-120) - This facility is used to perform full-scale research on launch vehicle liquid rocket engine systems, sub-systems, and components. Area 1-120 consists of three liquid rocket stands, with five firing positions, a control center and various support facilities. Vertical Stand 1A is a single position stand designed for 1 million pounds thrust liquid rocket systems. Vertical Stand 1B is a dual position stand designed for 6 million pounds liquid rocket systems. Stand 2A is a two-position horizontal stand designed for 460,000 pounds thrust LOX/LH2 component stand.

High Thrust Complex (Area 1-56) - This facility is used to perform full-scale research and development on high thrust launch vehicle solid rocket motors and liquid rocket engine systems. Located in Area 1-56 are two rocket test positions with thrust capability of up to 10 million pounds, the Shaft Preparation and Rocket Thrust (SPART) facility, two shop buildings, and a control center with offices. The test pad is 100 by 200 ft with a vertical wall, inset in the side of a large granite butte at a 3,000-ft elevation. The pad is unique in its ability to accommodate firings in the vertical (nozzle up), horizontal, or 15-degree positions.

Large Systems Complex (Area 1-125) - This facility is used to perform full-scale research on launch vehicle solid rocket motor systems and liquid rocket engine systems. Area 1-125 consists of three large rocket stands and necessary support structures and equipment. Stand 1C is configured with a six-axis system for measuring thrust from a solid rocket motor of up to 1.6 million pounds in the x-axis (vertical) and 200,000 pounds in the y-axis (horizontal). Stand 1D is capable of thrust measurements up to 2.5 million pounds of thrust, with four degrees-of-freedom and hydraulic calibration. Stand 1E, originally with the same characteristics of Stand 1D, is the location of the National Hover Test Facility (NHTF). The NHTF consists of a high bay hover and flight volume with adjacent control room, a target test stand, a vehicle integration facility with clean room, and areas for loading, servicing, and decontaminating propellants form test vehicles. The facility contains independent propellant storage and handling

EQUIPMENT/FACILITIES

capabilities, computer-controlled mirrored satellite tracking pedestal for locating and tracking satellite targets, and stand-alone telemetry systems.

Motor Behavior Complex (Area 1-36) - This facility is used to conduct full-scale research on solid rocket motors. Pad 1-36A is a beamed, horizontal position stand rated for thrusts up to 4 million pounds, typically used for thrust determination, structural integrity, and destruct system evaluation. The pad is 260 feet long by 55 feet wide with floor thickness ranging from 3 to 20 feet. Pad 1-36B is a vertical nozzle up facility rated for thrusts up to 4 million pounds. The facility consists of two 30 foot by 95 foot high towers resting on a 12 foot thick concrete pad. The towers are designed for six component thrusts measurement of 156-inch diameter motors. Pad 1-36D is a 150-foot diameter decomposed granite pad designed to support a 120-inch diameter solid rocket propellant motor with up to 1 million pounds of TNT equivalent propellant.

Physical Sciences Laboratory (Area 1-60) - This facility provides bench-scale experiment stations for the conduct of basic and applied research of liquid and solid propellants Area 1-60 consists of two large interconnected high bay laboratories, 25 smaller but distinct laboratories, six explosion resistant laboratory cells, offices, and various storage areas.

Propellant Laboratory Complex (Area 1-30) - This facility is used for the small-scale creation and evaluation of propellants, especially solid rocket propellants. In Area 1-30 there are over 30 buildings that support solid propellant research and development, formulating, mixing, casting, curing and measuring of physical properties of solid propellants. The facilities consist of shop support and motor case preparation work areas for solid motor propellant grains, test pads for rocket motors with thrusts up to 5,000 pounds, covering pads and bunkers for ready storage of propellants, and over 11 research cells, some of which are equipped with remote manipulators for processing high energy propellants. The area also contains environmental chambers used to condition and age rocket propellants, and laboratory rooms to prepare and analyze propellants and their constituents. The facilities can mix propellant from 1/4 to 50 gallons in quantity and conduct every test known for propellant hazard analysis.

Propellant Preparation Laboratory Complex (Area 1-21) - The facility is an isolated site dedicated to handling, cutting, milling, turning and trimming solid propellants and serves as support area for the Propellant Laboratory. Area 1-21 is an explosion resistant complex of nine cells built into the side of a granite ridge. Three solid propellant cutting cells are housed in the main facility. All machines in these cells are remotely operated and monitored by video from a central control room. Each piece of equipment is connected to a vacuum exhaust system, where the participants are soaked, flushed, contained and properly disposed of. Several cells are utilized for initial propellant preparation, solid propellant fragmentation testing, aging of solid propellant, and propellant storage. The cut and prepared solid propellants are utilized throughout the Propulsion Directorate's Edwards research complex.

Rocket Component Laboratory Complex (Area 1-70) - This facility provides laboratory and office space for research in advanced propulsion materials. Area 1-70 contains the facilities and equipment necessary to perform R&D in the application of composite materials to space missile systems. Numerous research, production and testing laboratories are housed in a single modern building. Approximately two-thirds of the building is high bay.

Satellite Propulsion Complex (Area 1-14) - This facility is used to conduct satellite scale research on next generation rocket engine materials, components, subsystems, and engines. Research rocket firings

EQUIPMENT/FACILITIES

encompass both storable and cryogenic systems, ranging from ground level to simulated altitudes of 120,000 ft. Experiments are accomplished in a number of approaches, using any of five test cells for static testing of liquid propellant engines; dynamic load effects created by a centrifuge; or liquid propellant flow distribution measurements in the hydrodynamic flow lab. The Solar Lab is housed in this complex, where R&D is conducted on solar energy and hydrogen uses.

Solid Propellant & Component Complex (Area 1-32) - This facility is used to conduct research scale programs on next generation rocket motor components, nozzle and case materials, propellant formulations, and subsystems. Area 1-32 consists of four main facilities along with support facilities and explosive storage bunkers. Pads 1 and 2 are designed to statically fire solid rocket motors at ambient pressures with thrust ratings up to one million pounds. The operating floor of the pad is 30 ft wide by 45 ft long. Pad 3 is designed for hazardous operations involving BATES motors and operations that involve the detonation of explosive materials. This area consists of four reinforced concrete pads (A through D), each of which is 18 ft wide by 20 ft long and approximately 18 inches thick. Pad 5 is designed to statically fire solid rocket motors at ambient pressures with thrust ratings up to 36,000 pounds. This area consists of three reinforced concrete pads (A through C), two of which are 10 ft wide by 20 ft long and one is 20 ft wide by 25 ft long.

Space Environmental Propulsion Complex (Area 1-42) - This facility is used to conduct research and development on next generation rocket motor and engine components, propellant formulations, and subsystems; and high vacuum research on satellite components, subsystems, and systems. Horizontal Cell 1-42D can test solid rocket motors of up to 20,000 pounds thrust fired in a horizontal position at simulated altitude of 100,000 ft. Overall size of the chamber is 10-1/2 ft in diameter by 25 ft in length. The Exhaust Containment Facility (1-42E) is designed to provide an area capable of handling the build-up and testing of environmental sensitive solid rocket motors at simulated altitudes up to 110,000 feet and 100,000 pounds of thrust. The motor cell is 40 ft long by 16 ft wide and can accommodate motors up to 30 inches in diameter by up to 84 inches long. Area 1-42 is comprised of five test pads, a control blockhouse, a steam generation plant, a 1.4M gallon cooling water tower, a shop area office trailers. The area has the capacity to store and transfer liquids and gases used in rocket motor research including to store and transfer liquids and gases used in rocket motor research including LN2, LOX, LF2, MMH, N202, LH2, GHe, H20, GN2 and propane. The steam generation plant has two bank of steam bottles and three sets of ejectors to provide altitude simulation to 100,000 ft. The Vertical Test Cell (1-42B) is designed for testing bipropellant liquid rocket engines with up to 50,000 pounds of thrust at simulated altitude to 100,000 ft. Overall size of the chamber is 16 ft in diameter by 28 ft high with a 16-ft diameter removable top cover. The Space Environment Simulation Facility (1-42C) can perform static tests simulating space at attitudes of up to 650,000 ft. The chamber is 30 ft diameter sphere is capable of achieving 1 x 10-6 Torr at temperatures of +300F or +400F.

X-33 Launch Complex (Area 1-54) - This facility serves as a launch site for the NASA/Lockheed X-33 vehicle. Area 1-54 is comprised of 103.9 acres with 21,539 sq ft of related facilities, which include the translating shelter for X-33 launch vehicle, Electrical Equipment Building, Launch Pad, Ground Interface Module, Office Trailers, and Storage for LH2, LO2, GN2, and GHe.

Propulsion Directorate
Wright-Patterson AFB, OH 45433-7251
(937) 255-2520

Director: Col. Alan M. Janiszewski
Deputy Director: Fred W. Oliver

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	1.406	0.306	5.802	7.514
6.2	27.677	23.478	81.624	132.779
6.3	4.406	1.285	59.610	65.301
Subtotal (S&T)	**33.489**	**25.069**	**147.036**	**205.594**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	19.036	19.036
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	1.524	1.397	47.686	50.607
TOTAL RDT&E	**35.013**	**26.466**	**213.758**	**275.237**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.020	N/A	0.000	0.020
Other	0.000	N/A	0.000	0.000
TOTAL FUNDING	**35.033**	**26.466**	**213.758**	**275.257**

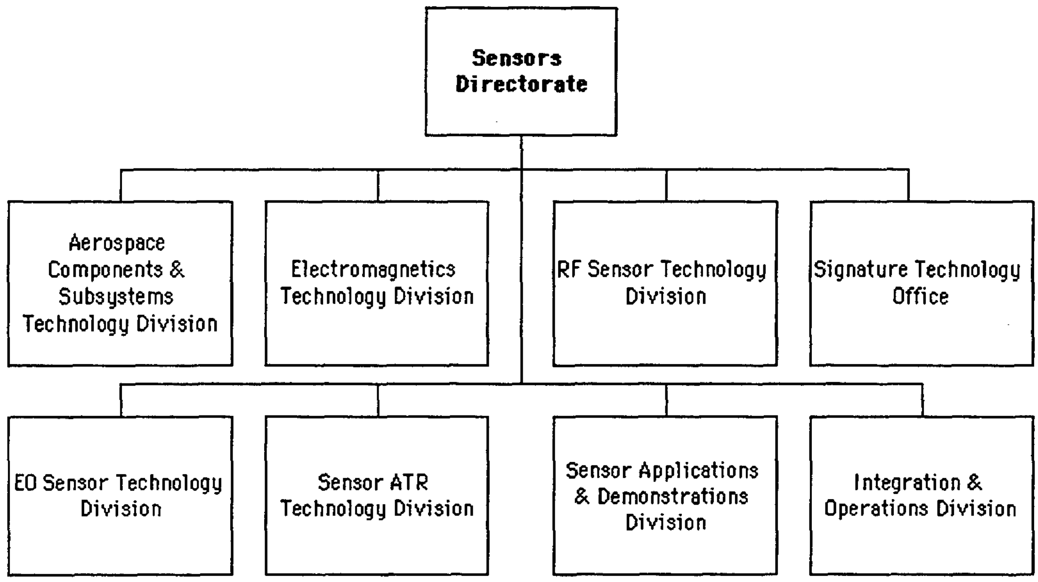
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	72	72
CIVILIAN	84	205	138	427
TOTAL	**84**	**205**	**210**	**499**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	1273.000	**REAL PROPERTY**	1651.000
ADMIN	16.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	130.000	**EQUIPMENT**	127.500
TOTAL	**1419.000**	* NEW SCIENTIFIC & ENG. EQUIP.	1.300
ACRES	**41642**	* Subset of previous category.	

Sensors Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Sensors Directorate
Wright-Patterson AFB, OH 45433-7320
(937) 255-2620

Director: Dr. Donald Hanson
Deputy Director: Col Larry Strawser

MISSION

Ensures unequaled reconnaissance, surveillance, precision engagement and electronic warfare capabilities for Americas air and space forces by conceiving, demonstrating and transitioning advanced sensors and sensor technologies in partnership with industry, universities and other DoD agencies, and providing knowledgeable support to the acquisition community and warfighters.

CURRENT IMPORTANT PROGRAMS

The following are just some of the current important programs/thrusts on which the Sensors Laboratory is working:

Large Aircraft Infrared Countermeasures (63270F): Threat-adaptable, laser based techniques to defend large signature aircraft from the growing infrared surface-to-air missile threat.

Advanced Tactical Targeting for Supression of Enemy Air Defenses (SEAD) (63270F): Affordable, passive SEAD techniques to allow multiple, non-dedicated platforms to cooperate in quickly deriving the precise location of a ground threat radar, even if it shuts down after emitting only briefly.

Command & Control Warfare (63270F): Advanced techniques to supress and counter adversary command and control networks.

Enhanced Recognition & Sensing Ladar (63203F): Laser radar (Ladar) technologies for positive air-to-ground target identification (ID) at longer, safer standoff ranges.

Common Situational Awareness (63203F): On-board mission management technologies to allow strike aircraft to use the latest intelligence information from off-board sources to improve re-routing capability, effectiveness, and survivability.

Automatic Target Recognition (63203F): Technologies and techniques to help warfighters quickly pick out potential targets from an increasing flood of information and reliably identify those potential targets as friend or foe, even at long ranges.

Tanks Under Trees (TUT) Initiative (63203F): Eliminate any sanctuary that ground mobile targets may gain using foliage masking, camouflage, communications silence, and/or decoys.

Foliage Penetration Synthetic Aperture Radar (63253F): Develop, fabricate and test a radar system for installation on a Global Hawk (Tier II+) Unmanned Aerial Vehicle (UAV), which can provide near real-time, automatic target detection and cueing of time critical targets hidden under foliage and/or camouflage.

CURRENT IMPORTANT PROGRAMS

Spectral Infrared Remote Imaging Transition Testbed (SPIRITT) (63203F): The objective of this ATD is to develop a day/night, high altitude, hyperspectral reconnaissance sensor testbed, demonstrate the technology for transition to the U-2 and Global Hawk UAV.

EQUIPMENT/FACILITIES

WRIGHT-PATTERSON AFB, OHIO

Name of Facility: ELECTRONIC WARFARE ANECHOIC CHAMBER (EWAC)
Facility Type: Electronic Warfare
Purpose: Develop and evaluate RF Electronic countermeasures techniques, devices and subsystems.
Primary Capabilities: 39Lx26Wx26H, electromagnetically shielded room lined with radio frequency (RF) energy absorbing material. Used for RF measurements, such as antenna polarization patterns, from 250 MHz to 100 MHz. Ability to test/evaluate most types of ECM hardware/techniques against hardware-in-the-loop simulations of seeker/target interactions.
Special/Unique Capabilities: Instrumentation systems for measuring and printing 3-D plots of angle error voltage developed by a monopulse tracking radar in response to polarization jamming.
Instrumentation: Wide range of microwave instrumentation.

Name of Facility: RF RECEIVER/PROCESSOR LABORATORY
Facility Type: RF Receiver and Processor
Purpose: Evaluation and development of new RF receiver, processor, and software concepts.
Primary Capabilities: Evaluation, test, evaluate, and develop new RF receiver systems in frequency range 2 to 18GHz. Research, evaluate, develop new threat sorting and identification software techniques.
Special/Unique Capabilities: Classified facility and screen room, capability of both laboratory and field research, and capability to collect and analyze special signals of interest.
Instrumentation: Prototype receivers-superhet, instantaneous frequency measurement, microscan, channelized, optical various RF transmission and modulation technique available. Sorting and identification software prototype available.

Name of Facility: OPTO-ELECTRONIC RESEARCH FACILITY
Facility Type: Coherent and Non-Coherent Optical Device Research
Purpose: Exploratory development of lasers, optical processing and control devices, opto-electronic integrated circuits, detectors and detector arrays.
Primary Capabilities: Characterization and evaluation of laser and non-linear materials. Optical device evaluation, including surface metrology, optical waveguide elements, optical logic and active optical processing evaluation. Infrared and ultraviolet optical detector characterization, evaluation and optimization, including optical Fourier transform measurement facility.
Special/Unique Capabilities: Optical excitation spectroscopy, time-resolved, for laser materials from 4 degrees Kelvin through elevated temperatures. Absorption, fluorescence and transmission spectroscopy from UV through long wave infrared. Interferometric and scatterometric surface analysis together with topographical surface microscopy for both insulating and conducting/semiconducting samples.

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Instrumentation: Multiple spectrometers and spectrophotometers; laser sources from visible through long wave infrared (10.6 micrometers). Bi-directional, reflectance distribution function measurement instrumentation for 4 inch surfaces at 3 visible wavelengths; Zygo surface interferometer.

Name of Facility: OPTICAL RESEARCH LABORATORY
Facility Type: Optical and Digital Seeker Processing
Purpose: Design, develop, and evaluate optical and digital processing technology; develop a standard math morphology for image processing; develop seeker algorithms.
Primary Capabilities: Main Lab: (1232 sq ft) Vibration isolated benches and computer workstations, Laser Polarimeter. Make measurements of the Kerr and Farady constants of infrared materials.
Special/Unique Capabilities: Only known achromatic infrared laser Polarimeter; computer driven spatial light modular for evaluation binary-phase-only-spatial filters. Optical/digital integration for image processing capability.
Instrumentation: Photometers, laser beam cross section analyzer, high speed oscilloscopes, CO_2, CO and solid state lasers, long and mid wavelength IR detectors. Spatial light modulators integrated wit high speed Sun workstation.

Name of Facility: MICROWAVE/MILLIMETER WAVE LABORATORY
Facility Type: Microwave/Millimeter Wave
Purpose: Design, simulate, fabricate and/or test microwave and millimeter wave electronic components and integrated circuits.
Primary Capabilities: Design, model and simulate solid state devices, integrated circuits and multi-chip assemblies operating in the 0.1 to 100 GHz frequency range. MMIC and multi-chip assembly performance and fabrication parameter correlation and data analysis. Design, fabrication and testing of GaAs MIMMICs; testing of a wide range of microwave/millimeter wave components.
Special/Unique Capabilities: Radio Frequency (RF) on-wafer testing of MIMMICs using a Cascade automatic prober and a Hewlett-Packard (HP) vector network analyzer. Load pull testing of high power devices using semi-automatic system employing automatic tuners operating in the 0.1 to 26GHz frequency range. Overstress testing of microwave devices and MIMMICs.
Instrumentation: PMI scalar network analyzer (1-40 GHz); HP8510 vector network analyzers (0.1 to 65GHz), On-wafer RF prober, Wiltron/HP load-pull measurement system; Ees of and Compact microwave computer-aided design software and workstations; and general purpose microwave/millimeter wave test equipment.

Name of Facility: MICROELECTRONICS COMPUTER AIDED DESIGN (CAD) & TEST FACILITY
Facility Type: Microelectronic
Purpose: Design and test microelectronic devices and integrated circuits. Maintain a state-of-the-art CAD facility.
Primary Capabilities: Very Large Scale Integrated Circuit (VLSIC) and analog circuit design. Development of FaAs-based heterojunction field effect transistors, heterojunction bipolar transistors and resonant tunneling devices. High speed testing of devices, circuits, and analog-to-digital (A/D) converters.
Special/Unique Capabilities: Silicon compilation of integrated circuits. Automated wafer parametric testing; automate A/D converter testing. Research and development prototype design tools.
Instrumentation: Electroglass automatic prober, Tektronics login analyzer, Hewlett Packard: parameter analyzer, impedance analyzer, switching matrix, sweep oscillator, data generator, rate

EQUIPMENT/FACILITIES

generator, oscilloscope, synthesized sign generator, LeCroy pulse generator, Fluke synthesized radio frequency signal generator, Stanford Research System amplifies, and general purpose test equipment.

Name of Facility: LASER RADAR RESEARCH LAB (LADAR)
Facility Type: Laser radar systems
Purpose: Research, test and develop high performance solid state laser radar and component technology.
Primary Capabilities: Development of new system integration technologies of laser radar systems. Can perform heterodyne detection and fiber optic mixing.
Special/Unique Capabilities: Uses non-mechanical beam agility device. Combines beam agility devices in the receiver portion of the laser radar system.
Instrumentation: Solid State 1.06um ND:YAG laser, consto-optic modulator, In GaAs detector, Faraday isolator, fiber couplers, digital oscilloscope. Two beam agility devices using liquid crystal phase grating concept using acoustic-optic defector modules.

Name of Facility: INTEGRATED DEFENSIVE AVIONICS LABORATORY (IDAL)
Facility Type: Hybrid/real-time digital simulation Laboratory
Purpose: To conduct integrated EW system/concept evaluate in support of Air Force Exploratory and Advanced Development programs.
Primary Capabilities: Real-time interactive, multispectral EW simulation to drive hardware system to digital emulation's.
Special/Unique Capabilities: Real-time interactive implementation of SUPPRESSOR command and control model, digital IR/EO scene generator, real-time digital RWR emulation. Interaction with DEES/CEE SIM RF environment generators, interaction with Integrated Test Bed Cockpit/Avionics simulator. Interaction with Electronic Defense Evaluator threat radar simulator.
Instrumentation: VAX 11/750, VAXstation 3, Sun 4, CCC3240, CCC3260 MPS.

Name of Facility: INTEGRATED AVIONICS LAB (IAL)
Facility Type: Avionics Research
Purpose: Conduct classified/unclassified, real-time/non-real-time, multispectral, multidisciplinary experiments, studies, research, simulations and analyses in the areas of integrated avionics, core processing architecture, information processing, communications, navigation, identification, software, life cycle support and machine intelligence.
Primary Capabilities: Real-time simulation of aircraft performing an operational mission allows evaluation of capabilities across entire spectrum of performance requirements. Provides a direct (non-extrapolated) view of real world problems and considerations. Validation of contract research products in a systems context.
Special/Unique Capabilities: Real-time simulation/stimulation of avionics interface signals. Generalized Avionics and Simulation/Integration Systems (GENASIS) software configurable simulated aircraft workstations. Real-time interface to defensive and communication avionics test facilities.
Instrumentation: Avionics flight processors with Ada operational flight programs and the avionics multiplex and fiber data buses. Models set include multiple aircraft, sensors, weapons and external environment modules; VAX 11/785/non-real-time development environment. GENASIS modular cockpit with six-nine inch diagonal color displays couple with F-15 type stick and throttle, moving map display, fiber optics communications.

EQUIPMENT/FACILITIES

Name of Facility: ELECTRONIC COMBAT RESEARCH SIMULATION LAB (ECRSL)
Facility Type: Electronic Combat Simulation
Purpose: Develop requirements for electronic combat equipment; evaluate electronic combat equipment.
Primary Capabilities: Three levels of digital simulation; one-on-one, one of many, and, campaign level (many-on-many).
Special/Unique Capabilities: Classified TEMPEST Facility.
Instrumentation: Electronic and data processing hardware.

Name of Facility: ELECTRO-OPTICAL RECEIVER LABORATORY
Facility Type: E-O Devices
Purpose: Research and evaluate IR and laser warning receivers.
Primary Capabilities: Calibrate, test, and evaluate infrared laser sensors and warning receivers in Bands I, II and III.
Special/Unique Capabilities: Classified facility with additional capabilities for foreign equipment exploitation. Capability for both laboratory and field research. Field research utilizes outdoor WL turntable facility located on WPAFB, OH, Area C, flight line for rotation for full-scale aircraft.
Instrumentation: Large array of optical, electrical, and data processing hardware in a facility comprising greater than 5,000 sq ft. Equipment account exceeds a value of $2M. Large optical collimator.

Name of Facility: DYNAMIC INFRARED MISSILE EVALUATOR (DIME)
Facility Type: Infrared Target Simulator and Multispectral Signature Generation
Purpose: Research and develop infrared countermeasures (IRCM) techniques and assessment of multispectral signature control techniques for EOCM.
Primary Capabilities: Provides semi-physical simulation of the homing interception of a target by an IR guided missile. Optiscan instrumentiation for evaluating IRCM effects upon infrared missiles. Interactive image processing system that allows aircraft signature modifications to be designed, modified, and evaluated by use of and image array processor.
Special/Unique Capabilities: Use actual IR missile optics and guidance electronics along with computer-simulated, aerodynamic characteristics and servo-controlled sources. Can manipulate imagery representing both the aircraft signature and camouflage treatment of interest. Multi-spectral tool to be used for signature analysis into the year 2000 and beyond.
Instrumentation: Operational IR missile guidance and control units. Digital aerodynamic computational capability. Servo-controlled IR sources/optics. SPIRITS generic sensor model.

Name of Facility: 100 INCH COLLIMATOR FACILITY
Facility Type: Electro-Optical Sensors
Purpose: Research, test and analysis of tactical and strategic electro-optical and laser radar systems under simulated environmental conditions.
Primary Capabilities: Profiling atmosphere in excess of 100 km. Sub-centimeter space debris experiment.
Special/Unique Capabilities: 100 inch diameter optical collimating mirror housed in vacuum chamber which can be evacuated to simulate a 270,000 ft altitude.
Instrumentation: Seismometers, 32 channel data logger, 8 channel digital recorder. PC-based computer system.

EQUIPMENT/FACILITIES

Name of Facility: DEVICE RESEARCH LABORATORY
Facility Type: Device and Semiconductor Research
Purpose: Research on compound semiconductors and semiconductor structures, advanced microwave, high speed digital and novel electro-optic devices.
Primary Capabilities: Theoretical and experimental research on III-V semiconductor structures and devices; development of advanced electronic and electro-optical devices. Extensive theoretical and experimental growth and characterization of electronic and optical properties of III-V materials and devices.
Special/Unique Capabilities: Molecular beam epitaxy of components of gallium; indium, aluminum, arsenic, and antimony; ion implantation; metal and dielectric deposition. Reactive ion etching; nanometer lithograph; modeling of device physics. Conventional and rapid thermal annealing; scanning electron microcopy and electrical testing.
Instrumentation: JEOL 5 DIIU-A e-beam; Varian 360 and GEN II MBE; full complement of conventional semiconductor process equipment. Time resolved high resolution photoluminescence; photoreflectance; hall measurement apparatus; Fourier transform infrared spectroscopy.

HANSCOM AFB, MASS

Facility: HYPERSPECTRAL IMAGING (HSI) INFRARED IMAGING PROCESSING FACILITY
Facility type: A real-time high speed imaging processing network.
Purpose: To process consecutive frames of infrared data at 12 bits dynamic range up to 400 frames per second.
Description: A high speed 100 megabit network connecting 30 computers to process field collected data.
Unique Features: ID of difficult targets using hyperspectral techniques.
Instrumentation: High speed midwave infrared cameras capable of processing up to 64 monochomatic images in near real-time.

Facility: BULK III-V GROWTH FACILITY
Purpose: To perform research and development on the crystal growth and preparation of III-V compounds with emphasis on producing bulk indium phosphide crystal substrates of high quality necessary for the next generation of photonic and electronic devices.
Description: The facility consists of a high pressure growth furnace of unique design and associated equipment for determining the quality of bulk material and substrate wafers. The furnace itself is inside a sixteen foot standing hood; disassembly is facilitated by a one ton crane on a monorail. In InP growth, the furnace maintains temperatures up to 1070 degrees Celsius at pressures exceeding 600 psi. An axial magnetic field can be applied during crystal growth. Associated equipment includes crystal cutting and wafer preparation stations. Hall effect measurements systems, and a photoluminescence system.
Capabilities: III-V single crystals can be grown by a variety of high pressure techniques. These techniques include the liquid encapsulation Czochralski method of pulling from the melt, and the liquid encapsulation Kyropoulous technique of top-seeded growth into a crucible, pioneered in this facility of InP growth. A strong magnetic field may be applied during growth to suppress turbulent convection in the melt. Indium phosphide may be synthesized in situ prior to growth using a unique phosphorus injection method. The hot zone of the furnace is large enough to accommodate growth of crystals up to eight inches in diameter.
Unique Features: The crystal growth system was designed by Rome Laboratory personnel. It supports the capability for in situ synthesis of indium phosphide prior to growth. Magnetic fields up to four

EQUIPMENT/FACILITIES

kilogauss may be applied during growth. Crystals of commercial dimensions may be grown to facilitate technology transfer.
Instrumentation: Fifty kilowatt radio frequency power supply and thirty kilowatt DC resistance heating supply for crystal growth. Computer controlled motors for rotation and positioning of crystals and crucibles. Crystal cutting saws and polishing equipment. Photoluminescence and Hall effect equipment for characterization. Characterization advanced electromagnetic techniques. Preparation and characterization support such as clean rooms and deep level transient spectroscopy are available in other Rome Laboratory facilities.
Location: Hanscom AFB, MA, Bldg 1142

Facility: SUPERCONDUCTOR THIN FILM FABRICATION/CHARACTERIZATION FACILITY
Purpose: To perform research and development on the fabrication of high temperature superconductor (HTS) films and structures for electromagnetic, devices, including microwave and millimeter wave devices.
Description: This facility supports research and development of the fabrication and patterning of large HTS films, and of multilayer structures for circuit elements and superconductive tunneling devices.
Capabilities: Film fabrication facilities included RF diode sputtering apparatus that has been modified for HTS deposition and a fully automated CVC SC-4000 three gun magnetron sputtering system. The CVC system, which was originally specified by Rome Lab, incorporates such features as a heated substrate holder and a fast oxygen source that are specially adapter to HTS film fabrication. A system for laser evaporative deposition is under construction. Equipment for sol-gel preparation of HTS films, e.g., high quality glove boxes and photo resist spinners, is available. The facility also includes an array of supporting fabrication and characterization equipment such as a SQUID magnetometer, furnaces, equipment for fabricating sputter targets, equipment for photolithography and patterning, a differential scanning calorimeter, and a differential thermal analyzer.
Unique Features: The tow sputtering systems have been modified to meet the unique and fast-changing demands of HTS research and development. The laser evaporative deposition system has been designed in-house by Rome Lab, and it will include, in addition to the deposition chamber, a chamber for Auger analysis of the deposited films.
Instrumentation: The sputtering and laser deposition units described above; a mask aligned and other equipment for patterning films; automated systems for measuring resistance and critical current as a function of temperature; a SQUID magnetometer for measuring dc magnetic susceptibility and apparatus for measuring the ac magnetic susceptibility. Scanning electron microscopy (including elemental analysis via EDS and WDS) and a variety of x-ray diffraction analysis techniques are provided through the Microcharacterization Facility. The Microwave characterization is provided by the Monolithic Microwave Integrated Circuit Facility.
Location: Hanscom AFB, MA Bldg 1141

Facility: PHOTONIC CRYSTAL/PHOTONIC GLASS FACILITY
Purpose: To perform research and development on linear and nonlinear optical (including photorefractive crystalline and glass materials for future Air Force applications that employ free-space signal, image processing and optical computing.
Description: The facility includes a variety of crystal growth and material processing systems. The Research Hydrothermal Growth System consists of 11 high temperature, high pressure autoclaves capable of growth from solution at temperatures up to 550 C and pressures up to 20,000 psi. This system is completely computer controlled. Melt growth capabilities include a twenty atmosphere system and a variety of systems for growth in controlled atmospheres. A top-seeded solution growth system

EQUIPMENT/FACILITIES

designed in-house operates at temperatures above 1400 C. Glass forming and annealing furnaces are available for processing in air or controlled atmospheres. Optical characterization is also available.
Capabilities: Crystals of photorefractive and other non-linear optical materials may be grown by several techniques, to assist in determining basic physical mechanisms and to optimize properties. When possible the same crystals are grown by several methods. Complete glass synthesis capacity, including both glass melting and sol-gel preparation techniques, permits investigation of novel nonlinear optical glass compositions.
Unique Features: The Research Hydrothermal Growth System is completely computer-controlled and supports the simultaneous operation of ten crystal growth autoclaves for growth runs in excess of 90 days. Multiple safety alarms and interlocks protect personnel. This the most extensive and comprehensive research Hydrothermal facility in the United States.
Instrumentation: Research Hydrothermal Growth System with local controls and computer. MP furnace capable of growth at 20 atm. Controlled atmosphere growth system. High temperature top-seeded solution growth (TSSG) furnaces. Spectrometers and apparatus for photoconductivity, optical absorption, and photoluminescence measurements. Fourier Transform Infrared Spectrometer. Additional x-ray characterization and analysis is available in the Microcharacterization Facility. Other sample evaluation techniques, e.g., differential scanning calorimetry and differential thermal analysis, are also available in Rome Laboratory facilities.
Location: Hanscom AFB, MA Bldgs 1142/1141

Facility: ELECTROMAGNETIC TECHNOLOGY RESEARCH FACILITY
Purpose: To investigate methods for design, construction, and testing of millimeterwave integrated circuit (MMIC) components; to research superconducting materials and their application to practical components; to conduct measurements of the radar cross-section of selected model targets; and to measure the properties of phased array antennas.
Description: 15,000 sq ft facility with a clean room; laboratories for MMIC magnetic and photonic research; and tow anechoic chambers.
Capabilities: See Purpose/Description
Unique Features: The facility is planned to have a near-field measurement range to characterize large phased array antennas in a controlled environment.
Instrumentation: No information available at this time.
Location: Hanscom AFB, MA, Bldg 1123

Facility: MONOLITHIC MICROWAVE AND MILLIMETERWAVE INTEGRATED CIRCUIT FACILITY
Purpose: To design, fabricate, and test monolithic microwave and millimeterwave integrated circuit (MMIC)
Description: A highly sophisticated mask layout program, a class 100 clean room, an ohmic contact annealing furnace, a vacuum station for electron beam metalization, a photo resist spinner, and ultraviolet exposure system, and several wire bonders all work together to give MMIC fabrication capability. Additionally, network analyzers are available to test MMIC components and upload experimental data in a format directly compatible with design software.
Capabilities: In addition to the design and test of MMIC components, the facility permits the integration of superconducting electronics and photonic circuits with MMIC components to offer better performance and the opportunity for less expensive electronics through wafer scale integration.
Unique Features: All critical design and test functions are consolidated on a single computer to allow rapid turnaround of experimental components.

EQUIPMENT/FACILITIES

Instrumentation: See Description.
Location: Hanscom AFB, MA, Bldg 1123

Facility: MICROCHARACTERIZATION FACILITY
Purpose: To perform chemical, crystallographic, and microstructural characterization of electromagnetic and photonic materials in response to requirements of photonic/electromagnetic materials and device development programs.
Description: This facility consists of equipment that utilizes x-ray and electron beam technologies to measure, analyze, and characterize microstructural properties of materials. X-ray diffraction techniques are used to perform phase identification, measure lattice parameters, orient single crystals, evaluate crystal perfection, and determine lattice match of epitaxial layers. Electron microscopy techniques reused to evaluate surface microstructure; to perform qualitative and quantitative chemical analyses of major and impurity constituents of materials; and to measure crystallographic properties of selected portions of samples.
Capabilities: Microstructural features can be imaged from 10X 300,000X with a resolution of 4 nm (secondary image) and 10 nm (backscattered image) on the scanning electron microscope (SEM). On the scanning transmission electron microscope (STEM), magnification ranges from 30X q 800,000X, with a resolution of 0.2 nm. Chemical analyses of elements having atomic numbers of 5 or greater can be performed routinely. X-ray techniques can measure lattice parameters with a precision of 0.00001 nm, and lattice match differences of epitaxial layers to 10ppm.
Unique Features: The SEM is equipped with a cold stage for examination of high temperature superconducting materials at temperatures as low as 80 degrees Kelvin.
Instrumentation: Scanning electron microscope equipped with both energy and wavelength dispersive spectrometers; scanning transmission electron microscope equipped with energy dispersive x-ray spectrometer and high resolution electron diffraction capability; automated x-ray power diffraction system; automated double crystal x-ray diffractometer; Lang topographic camera; Lauc and Debye-Scherrer cameras; x-ray generators; optical microscopes; micohardness tester, (Knoop and Vickers); and support equipment such as ion mill and evaporative coater.

ROME AFB, NEW YORK

Name of Facility: MICROWAVE PHOTONICS TECHNOLOGY FACILITY
Facility Type: Microwave Photonic Components & Subsystems
Purpose: Design, simulate/model, fabricate, test and evaluate latest state-of-the-art microwave photonic components. Fabricate/test experimental microwave photonic systems for Air Force C21SR applications.
Primary Capabilities: Design, fabricate, test and evaluate optoelectronic components, devices, integrated circuits, and multi-chip assemblies using computer aided design (CAD) for Air Force radar systems operating in the multiple GHz range. Design and characterize passively mode-locked lasers for the development of analog-to-digital converters using light absorbers.
Special/Unique Capabilities: One-of-a-kind facility that houses the latest diagnostic equipment for the testing and evaluation of optoelectronic components and subsystems consisting of lasers with full-spectrum wavelengths and power levels. Polymer compilation into integrated polymer-modulators. Automated wafer parametric testing. A/D converter testing. CDMA evaluation and testing for networks. Research and development design tools.
Instrumentation: Widely tunable 100 femtosecond chromium-doped YAG laser. 5 GHz bit error rate tester. 50 GHz spectrum analyser. Cascade microwave probe stations. HP microwave spectrum

EQUIPMENT/FACILITIES

analyzer system. Anritsu Optical Corp error detector. HP frequency agile signal simulator. Wiltron network analyzer system. Anritsu Optical Corp pulse pattern generator (0.05-5 GHz). Modeling and computer aided design complex. Fabrication laboratory of optical and electrical test structures. Specialized optical and electrical test apparatuses for polymer modulators. Dispersion and nonlinearity laboratory. ADC architecture test bed.

Name of Facility: SENSORS DIRECTORATE SURVEILLANCE FACILITY (SDSF)
Facility Type: Radar Sensor
Purpose: The Sensors Directorate Surveillance Facility is a versatile and unique testbed providing the capability to emulate, analyze, and evaluate developments in such areas as signal processing, ECM, ECCM, tracking, bistatics, multi-sensor fusion and target identification.
Primary Capabilities: Collect, evaluate and validate advanced radar concepts, techniques and processing approaches using experiments for ground-, air-, space-based and bistatic radar capabilities including clutter characterization, target emulation, real-time processing, high capacity data storage, and high fidelity radar modeling and analysis tools.
Special/Unique Capabilities: Highly flexible and programmable waveform generation. High bandwidth data acquisition. Real-time high performance computing and control. High fidelity radar simulation and modeling.
Instrumentation: The Sensors Directorate Surveillance Facility contains three separate radar systems: 1) an L-band surveillance radar, 2) an S-band tracking radar, and 3) a C-band phased-array radar system together with an electronic support measures (ESM) suite. The SDSF also includes several other labs including the Wideband ESM & Bistatic Suite/Bistatic Laboratory, the Static-Wing Antenna Laboratory and the Signal Processing Laboratory.

Sensors Directorate
Wright-Patterson AFB, OH 45433-7320
(937) 255-2620

Director: Dr. Donald Hanson
Deputy Director: Col Larry Strawser

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	IN-HOUSE	IN-HOUSE MANAGEMENT	OUT-OF-HOUSE	TOTAL
RDT&E:				
6.1 ILIR	7.728	N/A	N/A	7.728
6.1 Other	0.000	0.066	1.451	1.517
6.2	5.010	16.033	79.161	100.204
6.3	7.707	21.580	124.856	154.143
Subtotal (S&T)	**20.445**	**37.679**	**205.468**	**263.592**
6.4	0.501	0.102	3.956	4.559
6.5	0.000	0.000	21.821	21.821
6.6	0.000	0.000	0.000	0.000
6.7	0.261	0.668	14.565	15.494
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**21.207**	**38.449**	**245.810**	**305.466**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	0.000	N/A	0.000	0.000
TOTAL FUNDING	**21.207**	**38.449**	**245.810**	**305.466**

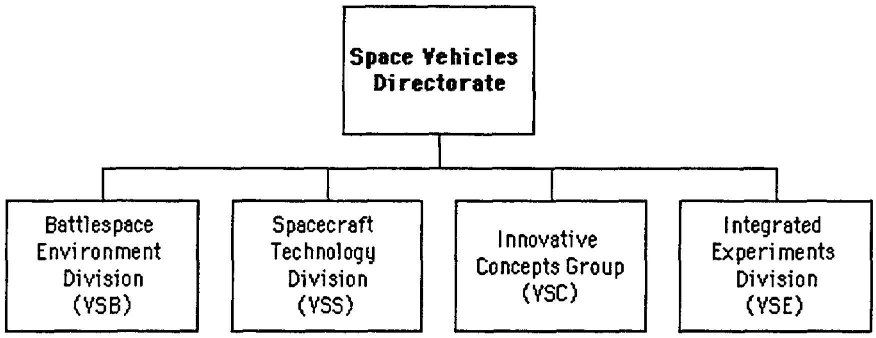
MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		TECHNICAL SUPPORT & OTHER PERSONNEL	END STRENGTH
TYPE	DOCTORATES	OTHER		
MILITARY	13	49	11	73
CIVILIAN	69	351	122	542
TOTAL	**82**	**400**	**133**	**615**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		PROPERTY ACQUISITION COST (MILLIONS $)	
LAB	279.336	**REAL PROPERTY**	181.445
ADMIN	121.109	* NEW CAPITAL EQUIPMENT	0.150
OTHER	53.149	**EQUIPMENT**	43.500
TOTAL	**453.594**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**100**	* Subset of previous category.	

Space Vehicles Directorate

FY2000 Abbreviated Functional Chart - Technical Organizations



Space Vehicles Directorate
Kirtland AFB, NM 87117-5776
(505) 846-6243

Director: Christine M. Anderson
Deputy Director: Col Richard A. Kniseley

MISSION

Innovate, develop, integrate and transition science and technology for, effective and affordable space vehicles, launch vehicles, and space concepts supporting America's Aerospace Force.

CURRENT IMPORTANT PROGRAMS

AFRL/VS Technology (By Division)

AFRL/VSB Battlespace Environment Division Programs

Global Ionosphere and Neutral Atmosphere Specification and Forecast: Global models of the ionosphere and the neutral upper atmosphere are being developed to specify and forecast space environmental effects on combat systems. The models are physics-based and designed to assimilate environmental measurements in near real-time to provide the best possible specifications and forecasts. The models exploit the coupled physics of the Earth's ionosphere and upper atmosphere. Applications for the models include selection of optimum C3I-system operating frequencies and modulation schemes, reduced space surveillance tracking and range errors, increased GPS navigation accuracy, reduced geolocation errors, improved forecasts of scintillation, and improved predictions of satellite drag effects including collision avoidance requirements and re-entry locations and forecasts.

High-Frequency Active Auroral Research Program (HAARP): A key objective of this Congressional add program is the identification and characterization of the physical processes that can be initiated in the atmosphere, ionosphere and space via interactions with high power radio waves. Research objectives are to investigate plasma instabilities and turbulence; electron acceleration, including the production of optical and infrared (IR) emissions; the generation, maintenance, and/or suppression of ionization structures aligned along the Earth's magnetic field; the modulation of currents in the ionosphere, thereby producing virtual antennas in space to generate ULF/ELF/VLF radio waves; and the production of stimulated electromagnetic emissions (SEE). The efficiencies that can be obtained in the initiation, maintenance, and control of such processes and techniques to excite selected (individual) processes, or to suppress unwanted ones, are also research areas of increasing interest. Other program objectives include experimental research to assess the potential for exploiting this emerging ionospheric technology.

Operational Space Environment Network Display (OpSEND): This product provides the theater warfighter with real-time maps of space weather impacts on UHF satellite communications and HF systems. It monitors disturbances in the ionosphere that routinely degrade the performance of space-based communications, navigation, and RF surveillance systems. It also provides real-time estimates of the accuracy of single-frequency GPS systems, and estimates of the performance of HF propagation systems.

CURRENT IMPORTANT PROGRAMS

Scintillation Network Decision Aid (SCINDA): SCINDA is a system of ground-based sensors and software designed to detect and predict the occurrence of ionospheric scintillation and to specify and predict its effects on C3I systems. Ionospheric disturbances cause rapid phase and amplitude fluctuations of satellite signals observed at or near the Earth's surface. SCINDA is used to specify and predict the degradation of satellite communication and navigation signals due to ionospheric scintillation in the equatorial region.

Vehicle-Generated Charged Particle Effects: Program develops technologies to predict and mitigate re-entry blackout effects on GPS navigation, communications, and sensors, and to predict and mitigate signatures associated with re-entry and hypersonic flight. Re-entry blackout and signature effects are predicted for advanced systems under development such as Common Aero Vehicle (CAV), Military Spaceplane (MSP), Conventional ICBM, Ballistic Missile Replacement, and other advanced systems. Recent developments include design optimization for minimizing re-entry blackout of GPS navigation for a missile technology demonstration flight test. The basic research component of the program investigates the underlying chemistry and physics that lead to effects on systems and investigates potential breakthrough technologies for hypersonics.

AF-GEOSpace: AF-GEOSpace is a software package designed to provide a user-friendly graphical interface to a variety of near-Earth space environment models and applications with an emphasis on three-dimensional visualization. AF-GEOSpace includes models of the radiation belts based on measurements by the Combined Release and Radiation Effects Satellite (CRRES), which was flown from 25 July 1990 to 12 October 1991 during solar maximum. AF-GEOSpace also includes the Parameterized Ionospheric Model and models of ionospheric scintillation, ionospheric three-dimensional ray-tracing, energetic particles and conductivities in the auroral regions, and magnetic fields. These empirical, statistical, and physics-based models provide environmental information required for spacecraft design, mission planning, satellite operations, and C3I system design and operations. AF-GEOSpace is also an effective tool for magnetospheric and ionospheric research and education.

Charge Control System (CCS): CCS is an autonomous monitoring and control device designed to prevent damaging levels of charge buildup on geosynchronous spacecraft. CCS was launched 31 July 1995 on Defense Satellite Communication System (DSCS) satellite B-7. It provides the first autonomous system that detects dangerously high voltage levels of spacecraft charging and initiates a plasma source to bathe the spacecraft in a protective environment until the hazard disappears.

Compact Environmental Anomalies Sensor Experiment (CEASE): CEASE system is designed to measure and predict on-orbit spacecraft anomalies resulting from interaction with the Earth's radiation environments. CEASE consists of a series of charged particle radiation detectors located within shields representative of spacecraft electronics boxes and components that is flown in the Earth's radiation belts that monitors intensity variations with time. It provides real-time space hazard warnings (anomaly avoidance), detailed space environment data (anomaly analysis). Total radiation dose, radiation dose rate, deep dielectric charging, surface dielectric charging, single event upsets. Upcoming CEASE flights on TSX-5, STRV-1c and DSP are planned. CEASE is an integral component of the Spacecraft Survivability and Protection Program and is planned to be included as part of the Satellite Threat Warning System on future US Military Spacecraft.

CURRENT IMPORTANT PROGRAMS

Digital Ion Drift Meter (DIDM): DIDM is a highly advanced ion drift, ion temperature, and ion density sensor utilizing miniaturized state-of-the-art detector components and on-board digital signal processing. The follow-on US meteorological satellite program (NPOESS), which will replace DMSP early in the next century, requires higher resolution, sensitivity, accuracy, and dynamic range for its plasma measurement devices. The goal is for a next generation DIDM instrument to be the standard drift meter aboard the NPOESS spacecraft. CHAMP Satellite Status: the first DIDM unit was launched on the Space Test Program's STEP-4 spacecraft in October 1997. A second, more advanced prototype is being developed for launch aboard the German CHAMP experimental satellite in mid 1999.

Magnetospheric Plasmas and Field Effects: The objective of the program is to conduct computer modeling and analysis of data collected from ground-based and space-based instruments that can detect important characteristics of the Earth's magnetosphere. Research applications include specifications and predictions of magnetospheric particle populations that address such problems as spacecraft charging, radiation dosage, and single event upsets.

Magnetosphere/Ionosphere Coupling: The objective of the program is to conduct computer modeling and analysis of data collected from ground-based and space-based instruments to study coupling processes between the Earth's magnetosphere and ionosphere, with special emphasis on ionospheric impacts. Research applications predict magnetic field variability, the onset of equatorial irregularities, magnetic storms, and substorm electrodynamics.

Relativistic Electron and Energetic Proton Experiment (REEPER): REEPER provides improved space radiation models and forecasting capabilities, better support to space environmental coverage and modeling requirements. Program includes research to differentiate high-energy inner-zone protons and electrons, measure outer zone electrons over wide dynamic range, and create database with adequate energy and angular resolution.

Solar/Interplanetary Monitoring, Modeling, and Disturbance Forecasting: The objective of this program is to observe, model, and predict the solar disturbances that impact the aerospace environment and AF systems that operate therein. These disturbances include: (1) solar flare electromagnetic emissions that can cause natural jamming of radio receivers and blackouts of high-frequency communications; (2) solar energetic particles that pose a radiation threat to spacecraft as well as to personnel in space; and (3) solar plasma clouds that cause geomagnetic storms and heat the neutral atmosphere, resulting in increased atmospheric drag on satellites and shortened mission lifetimes.

Turbulence in Space Plasmas: Mathematical and computational methods for studying turbulence in space plasmas are being developed. Plasma turbulence occurs at both low latitudes and high latitude and can affect the operation of systems such as GPS (Global Positioning System), AFSATCOM and DSCS satellites.

<u>AFRL/VSB Optical and Infrared Technology Programs</u>

Hyperspectral Imaging (HSI) Data Analysis: The HSI Data Analysis program is developing HSI tools to analyze data from the two VS space-based HSI experiments: Warfighter-1 (WF-1) and Fourier Transform Hyperspectral Imager (FTHSI). Space-based data is corrected for both instrument effects and the effects of the atmosphere, calibrated, and processed with a wide suite of target detection and terrain

CURRENT IMPORTANT PROGRAMS

classification algorithms. This data analysis will be used to validate techniques and algorithms to accomplish theater-wide surveillance and cueing, large area terrain classification for intelligence preparation of the battlefield (IPB), target detection and identification (TDI), battle damage assessment (BDA), monitoring deployment of weapons of mass destruction, and counter narcotics. In addition to the atmospheric compensation code being developed under the Atmospheric Radiance and Transmission Model work, algorithms for automated detection of targets and terrain types are being developed and tested.

Atmospheric Transmission and Background Specification and Clutter Mitigation Models: Models of atmospheric transmission and radiance and related databases are in continuous development to expand their spectral domains and to include new or improved representations of atmospheric constituents. The Moderate-resolution Transmittance (MODTRAN) Code is widely used in the remote sensing community to calculate atmospheric transmittance and radiance for wavelengths from ultraviolet through infrared at moderate spectral resolution. The Synthetic High-Altitude Radiance Code (SHARC) is the DoD standard for simulating high-altitude (50-300 km) backgrounds at wavelengths from ultraviolet through long-wavelength infrared. An advanced version of SHARC, designated SHARC4, adds atmospheric structure to the radiance description and, in conjunction with the SHARC Image Generator (SIG) code, provides scene generation capability. The Fast Atmospheric Signature Code (FASCODE), a first-principles, line-by-line atmospheric radiance and transmittance code, is the standard benchmark for the evaluation of atmospheric background codes based on band-model approaches to radiation transport. FASCODE is applicable from the visible to long-wavelength infrared and is generally used to calculate atmospheric radiance and path transmission at low altitudes; it can be used for non-equilibrium high-altitude calculations if supplied with the appropriate vibrational-level temperatures. The Moderate Spectral Atmospheric Radiance and Transmittance Code (MOSART) calculates atmospheric transmission and radiance in the ultraviolet through microwave spectral region at low altitudes for line-of-sight paths within the atmosphere and for paths which intersect the Earth's surface. SHARC and MODTRAN Merged (SAMM) is a recently developed code that provides seamless coverage of radiance and transmittance over the entire altitude range from the Earth's surface to 300 km. CBSD (Celestial Backgrounds Scene Descriptor) provides spectral radiance and 2-D integrated band radiance scenes of solar system objects, point source stars, zodiacal light, and galactic IR cirrus clouds. PLEXUS (Phillips Laboratory Expert User Code) is a user-friendly expert system that integrates and widens the accessibility of our family of atmospheric and astronomical background codes. These models, which specify and predict background clutter, are being validated and updated by analysis of data acquired by airborne and space based sensors. The data span the short-, medium-, and long-wavelength infrared and include a wide variety of background scenes and global clutter statistics. Laboratory measurements and theory are also fundamental inputs to the models.

Flying Infrared Signatures Technology Aircraft (FISTA): FISTA carries a suite of instrumentation to measure infrared signatures of aircraft, missiles, and backgrounds. The data are used to evaluate specification compliance, support analyses of vulnerability and survivability and the development of IR countermeasures, and develop models for aircraft simulation and threat scenario analysis.

Midcourse Space Experiment (MSX): The MSX program, established by the Ballistic Missile Defense Organization, is a functional demonstration of target detection as well as a background measurements program. The MSX Earth Limb and Terrestrial Backgrounds Team generated a series of well-documented reference scenes of infrared backgrounds of unprecedented quality for the SBIRS community to assist in the design of the next-generation infrared (IR) surveillance systems. The MSX

CURRENT IMPORTANT PROGRAMS

measurements include the first infrared observations of several atmospheric phenomena that present newly identified sources of background clutter. These include atmospheric gravity waves, stratospheric warming, and polar mesospheric clouds. The MSX Celestial Backgrounds Team also collected and analyzed an outstanding set of celestial backgrounds in several IR bands. This celestial data has been collected in catalogs that provide precision pointing and radiance calibration sources for the surveillance community, including SBIRS. The MSX data provide the first definitive measurements of infrared backgrounds at the spatial scales, sensitivity and wavelengths needed to support both current and future requirements for infrared space surveillance systems. The MSX reference scene data, the validated models of atmospheric background radiance and spatial structure, and the celestial background data and models provide a basis to assess the impact of background clutter on the performance of proposed and conceptual infrared surveillance systems. The data and models provide the design tools that cover the full surveillance trade space to the system engineers of the Space-Based Infrared System (SBIRS) managed by SMC and the designers and architects of theater and national missile defense systems managed by BMDO.

SBIRS Phenomenology Data Archive Center (PDAC): The SBIRS PDAC is a repository of background scenes and statistical descriptions of short-wavelength and medium-wavelength infrared background clutter. The data are used to support clutter model development and to guide the development of surveillance systems.

See Through Clouds (STC): The STC program seeks ways to mitigate the effect of intervening cloud cover on the interpretation of data from surveillance satellites. A combination of airborne measurements and modeling is used to evaluate sensor design and algorithms that will permit identification of ground-based targets under all weather conditions.

Spectral and In-Band Radiometric Imaging of Targets and Scenes (SPIRITS): SPIRITS is a software package of infrared signature models of aircraft and missiles. Its functional sections include aircraft engine characteristics, mixing of engine exhaust with ambient air, rocket plume radiance, and reflectance and emission from targets and backgrounds. Models for the ALCM, B-1B, B-52, C-17, C-130H, F-15, F-16, KC-10, and KC-135R have been developed from measurements by FISTA.

Atmospheric Turbulence Measurement and Modeling: The objective of this program is to develop improved models of atmospheric optical turbulence in order to predict the performance of next-generation laser systems for directed energy, communications or remote sensing. The current focus is on high energy laser (HEL) systems, either ground, air- or space-based, with special emphasis on the Airborne Laser (ABL). The challenge is to develop models of optical turbulence that are applicable to long, near horizontal slant paths and that include the full variability of turbulence with atmospheric conditions. Measurements are an integral part of this program and a new generation of balloon-borne turbulence sensors has been developed and is being used with high-resolution GPS-based radiosondes to measure vertical profiles of turbulence. Under ABL sponsorship, a series of measurement campaigns in theaters-of-interest have been conducted in various seasons. These measurements have made critical contributions to the development of the ABL. In addition, this data significantly augments the data from other measurement campaigns, yielding a unique database of optical turbulence that provides a foundation for the model development efforts. The model development approach is to couple a turbulence model with a mesoscale weather model in order to represent the full atmospheric dynamics. The ultimate objective is to produce operational decision aids for the ABL and other laser systems.

CURRENT IMPORTANT PROGRAMS

Cloud Scene Simulation: A capability is being developed for high-fidelity simulation of clouds and related atmospheric phenomena including rain, fog, and wind. Objectives include the development of new models and algorithms for generating synthetic cloud environments, radiometric (through-the-sensor) cloud scenes, and quantifying the impacts of clouds on military operations. Development of an advanced atmospheric scene simulation model will meet rapidly growing demands for realistic system simulation in joint warfare models. The advanced model will include efficient algorithms for scene visualization and will use data structures and procedures consistent with Distributed Interactive Simulation (DIS) requirements.

Contrail Analysis and Forecasting: A statistical contrail prediction algorithm based on radiosonde data was developed to determine the likelihood that an aircraft flying in a certain environment will produce contrails. This algorithm provides a dramatic improvement in contrail forecasts when compared to the operational contrail prediction algorithm now used by Air Force Weather Agency. Work has begun to incorporate numerical weather prediction output and satellite sounding and imagery data to improve the algorithm.

Weather Impact Decision Aids (WIDA): WIDA is a multi-faceted program to develop decision-aids for electro-optical weapon sensing systems to support warfighter mission planning and decision-making activities. Night Vision Goggle Operations Weather Software (NOWS) is designed to give mission operations planners information on how nighttime environmental conditions will affect the mission; version is being transitioned to users in December 2000. Infrared Target Scene Simulation Software (IRTSS) provides realistic target area scene visualizations for combat aircrews. IRTSS integrates physical models that calculate target/background contrast. In addition, atmospheric transmission, weapon sensor performance, weather data, geographical background data, and target parameters can be modeled. Target Acquisition Weather Software (TAWS), which predicts detection and lock-on ranges for electro-optical weapon and target acquisition systems, replaced the Electro-Optical Tactical Decision Aid (EOTDA), which was in operational use by combat air forces since the early 1980's. TAWS Version 2.2 is being transitioned to operational users in December 2000. Weather Automated Mission Planning Software (WAMPS) is the integration of the TAWS capability into the Joint Mission Planning System used operationally by pilots for tactical planning. The Joint Environmental Exploitation Segment is incorporating the TAWS capability into the Theater Battle Management Core Systems to provide stoplight guidance for weapon selection and sortie planning during the generation of the Air Tasking Order and for Time Critical Targeting.

AFRL/VSC Innovative Concepts Group Programs

XSS-11: The objective of this program is to demonstrate key elements of extended proximity operations using microsatellites. An agile, capable, affordable microsatellite will rendezvous with a resident space object and perform extended proximity operations including standoff inspection and circumnavigation. Key technologies are the proximity operation software/algorithms, miniature proximity sensors including a laser ranger, producible and capable microsatellite bus with a modular payload interface, and command and control techniques for proximity operations including safety and verification procedures. The satellite will be launched in Oct 2003 and will be operated for one year.

CURRENT IMPORTANT PROGRAMS

AFRL/VSE Integrated Experiments Division Programs

Ballistic Missile Technology: The Ballistic Missile Technology (BMT) program within the Air Force Research Laboratory Space Vehicles Directorate is responsible for Science and Technology programs related to USAF ballistic missiles. BMT develops and demonstrates advanced technologies necessary for current Minuteman life extension programs. BMT also develops ballistic missile enhancements to: respond to emerging threats; reduce cost of development, production, operations, and maintenance costs; and apply technologies common to the directed D-5 missile life extension and the replacement of the Minuteman III missile. BMT supports Air Force Space Command Force Applications requirements for Ballistic Missile Replacement (BMR) technology to develop the next generation guidance/navigation/control (GNC), and advanced re-entry systems for replacement of the Minuteman Missile III system. BMT's approach is to utilize a series of Missile Technology Demonstration (MTD) flights to provide data for both range safety instrumentation and terminal guidance. These experimental flights will furnish flight data for evaluating a number of technologies needed for the next generation ballistic missile. Those technologies include advanced GPS/INS navigation systems capable of GPS reacquisition after re-entry plasma blackout, specialized GPS antennas and antenna windows, jamming-resistant miniaturized GPS receivers, advanced re-entry vehicle designs capable of meeting mid- and far-term GNC requirements, and high temperature materials capable of withstanding demanding re-entry conditions.

Communication/Navigation Outage Forecasting System (C/NOFS): The Space Vehicles Directorate of the Air Force Research Laboratory is developing the Communication/Navigation Outage Forecasting System (C/NOFS) that will be the first-ever system for continuous global scintillation forecasts of communication and navigation outages to minimize mission C3 impacts. When C/NOFS begins its mission in 2003, it will deliver a brand new kind of forecast product to operational users. C/NOFS will alert the U.S. warfighter of impending UHF and L-band satellite communication outages, GPS navigation degradations, and Space-Based Radar tracking errors caused by equatorial ionospheric scintillation. The goal of C/NOFS is to forecast scintillation four to six hours before its onset such that system operators will be able to plan in ways that will optimize mission command and control. The Air Force Research Laboratory is also investigating technologies to provide long-term, global forecasts of ionospheric scintillation. Currently, the Department of Defense (DoD) does not have a capability to forecast ionospheric scintillation. Along with the DoD, the National Space Weather Program and the National Security Space Architect have defined a need for scintillation specification and forecasting, and have specifically documented the need for C/NOFS. C/NOFS includes three core elements: a space-based sensor suite to make in-situ and remote sensing ionospheric measurements; ground sensors to augment theater coverage for scintillation specification (i.e., regional nowcasting); models and user products to provide tailored outage forecast maps for the warfighter. C/NOFS is a joint effort between the DoD Space Test Program (SMC/TEL) and the Air Force Research Laboratory. The C/NOFS space flight is officially manifested for a 2003 launch. C/NOFS has also been designated by OSD as an Advanced Concept Technology Demonstration (ACTD) and will conduct a prototype operational demonstration of its forecasting capability following the first year of operations.

MightySat I: The MightySat I program is an USAF satellite that demonstrated new technologies in space. It was the first in a series of low-cost Air Force Research Laboratory small satellites to quickly and inexpensively explore, demonstrate, and transition space technologies from the research phase to operational use. The 140-pound satellite was launched from the Space Shuttle Endeavor in December 1998 and performed robustly in orbit, with no spacecraft anomalies during its mission. MightySat I's

CURRENT IMPORTANT PROGRAMS

mission ended when it re-entered the atmosphere at 1711 Zulu on 21 November 99. Operators from the Space and Missile Systems Center Test and Evaluation Directorate (SMC/TE) monitored on-orbit performance from their center at Kirtland Air Force Base, New Mexico. The MightySat II program is a follow-on series of spacecraft that will provide AFRL with a "lab bench" for responsively testing emerging technologies to ensure their readiness for operational Air Force missions, such as Picosatellite technologies and Hyperspectral Imaging.

MightySat II.1: MightySat II.1, the first satellite in the second series of MightySat spacecraft, is a robust, 3 axis stabilized platform that continues the "space lab-bench" concept of the MightySat program. On July 19, 2000, MSat II.1 was successfully launched from VAFB on the Air Force's new Minotaur launch vehicle into a 550KM sun synchronized polar orbit. MSat II.1's 10 payloads are comprised of both stand-alone experiments and experimental bus components. MightySat II.1 features its primary payload, the Fourier Transform Hyperspectral Imager (FTHSI) and has successfully been providing the first HSI images from space. Additionally, FTHSI demonstrates the benefits of an alternative method of hyperspectral imaging using a monolithic glass interferometer and on-board image data processing. Also, a pair of tethered, autonomous Picosats will be ejected late in the MSat II.1's mission, helping to demonstrate dynamics of ejecting small bodies from the main spacecraft and as a pathfinder use of small satellites in "constellations." The 263 lb. MightySat II.1 also features a solar array concentrator, a shaped memory alloy experiment and a new generation of miniature SGLS S-band transponder including encryption capability. The multi-functional composite structure of the MightySat II.1 bus provides insight into developing spacecraft structures combining both thermal and structural properties aimed at optimizing mass, cost and construction simplicity. MightySat II.1 mission operations are conducted through the RDT&E Support Center (RSC) of SMC/TE at Kirtland AFB.

Scorpius: The Scorpius program is designed to quickly provide low cost surrogate target vehicles and to provide expendable launch vehicles to the Air Force at a cost of 10% to 20% of that of current vehicles. The surrogate target vehicle, SR-M, is designed to simulate a SCUD B. The first orbital vehicle, Sprite, will carry a small payload to low earth orbit. The first Scorpius vehicle, SR-Sa, was successfully launched from White Sands Missile Range on 27 Jan 99. The SR-M precursor, SR-XM, is scheduled for launch in Feb 01. The Scorpius program has produced the state of the art in ablative liquid rocket engine technology; having successfully fired numerous 5,000 lb thrust engines for their design life of 200 sec. In production mode, these engines are predicted to cost on the order of $2/lb of thrust. A 20,000 lb thrust engine has also been designed, fabricated, and successfully initially tested.

Military Spaceplane System: The Military Spaceplane System (MSP) is a reusable space architecture capable of providing aircraft-like operability, flexibility, and responsiveness, and supporting AF Space Command mission areas. The MSP Architecture includes the Space Operations Vehicle (SOV), a reusable first stage and booster; the Space Maneuver Vehicle (SMV), a reusable upper stage and satellite bus; the Modular Insertion Stage (MIS), a low cost expendable upper stage; and the Common Aero Vehicle (CAV), a maneuvering re-entry vehicle for bringing payloads down through the atmosphere. The MSP Architecture heavily leverages work being done by NASA. NASA's X-33 is a technology leader for SOV, X-37 leads SMV, and Upper Stage Flight Experiment leads MIS. X-37, in particular uses a very similar outermold line to Boeing's SMV concept, and lessons learned from X-37 will transfer directly to a planned SMV demonstration program. Once fielded, the MSP will offer revolutionary capabilities in on-demand launch, high sortie rates and rapid turn times.

CURRENT IMPORTANT PROGRAMS

Solar Orbit Transfer Vehicle: The Solar Orbit Transfer Vehicle program is developing new space capabilities around the concept of a highly mobile spacecraft. A very large velocity change capability will lead to derivative vehicles capable of asset repositioning, satellite rescuing, graveyarding, high altitude refueling, servicing, inspection, taskable earth observation and numerous space control activities. The unique concept uses highly efficient propulsion and power system that can deliver about three times the mobility of current technology. The technology uses a direct thermal transfer of solar energy into the propellant and electrical power converters. The program is oriented toward development of multiple derivative concepts, advancement of component level technologies, and the integrated space experiment and demonstration of the capabilities. Several directorates of AFRL jointly support the effort; two NASA centers, and augmented by the IRAD of several industry corporations

Techsat 21: The Techsat 21 program is a new way to perform missions from space by using clusters of micro-satellites that operate cooperatively to perform the function of a larger, single satellite. Each smaller satellite communicates with the others and shares the processing, communications, and payload or mission functions. Thus, the cluster of satellites forms a "virtual satellite," an idea characterized by the Air Force Scientific Advisory Board Space Technology Panel as the technology that will lead to new exploitation of capabilities in space. This concept promises many benefits, including greater utility and flexibility by permitting the cluster to reconfigure and optimize its geometry for a given mission, enhanced survivability, and increased reliability. It is expected that clusters will reduce life cycle cost by using mass-produced satellites and minimizing the launch cost by optimizing the launch vehicle's cargo capacity. The cluster concept also eases performance upgrades by allowing upgraded satellites to join a cluster, increasing the overall performance of the virtual satellite rather than replacing a single, large satellite or the entire cluster.

Warfighter 1: Warfighter-1 (WF-1), the first project in the series, is an Advanced Technology Demonstration (ATD) that involves the development and launch of a hyperspectral imaging satellite. The program is addressing, through the use of new technologies; selected surveillance related deficiencies and needs of AFSPC and the Space Warfare Center. Once the satellite is in orbit, hyperspectral technologies will be evaluated and validated. Development of a mobile ground station with related data processing algorithms and software for tactical operations would also be evaluated. Warfighter-1 also leverages off commercial industry, whereby the Air Force will pay for the development and integration of a hyperspectral imaging capability on a commercial remote sensing satellite.

XSS-10: The XSS-10 program is a USAF satellite that is developing and demonstrating micro-satellite (10-100 kg) technologies to support operational deficiencies such as surveillance, communications, navigation, and logistics. It explores technologies necessary for satellite proximity maneuvering, observing, and manipulation, and for the rapid deployment of satellites for emergency surveillance, satellite inspection, and servicing requirements. One micro-satellite will be launched on a Delta II in October 2001.

AFRL/VSS Spacecraft Technology Division Programs

Space Electronics and Protection Branch (VSSE)
Improved Space Computer Program (ISCP): The program objective is to reduce the development time and cost of future, high-performance DoD space missions by optimizing how signals and data are handled on-board satellites. This is accomplished by developing a flexible and scalable computer

CURRENT IMPORTANT PROGRAMS

architecture that is based on an open systems approach (standards based). Flexibility is defined as the ability of the architecture to satisfy the processing requirements of a wide range of satellites. The term also refers to the degree to which the architecture can support various technologies. Scalability refers to the degree to which the architecture can support a range of processing requirements. The computer architecture will provide improved throughput performance to meet demanding processing needs for the next century. Modules will address a full range of space/radiation hardened microelectronics needs. ISCP enables the support of next-generation space operations by providing users with a capability for autonomous mission operation, going beyond spacecraft control to increasingly independent information gathering, on-board hyperspectral data analysis, and data dissemination. ISCP modules will greatly increase the "intelligence" of spacecraft while reducing the size, weight, and power cost drivers.

Chalcogenide-Based Random Access Memory (C-RAM): C-RAM is a program to develop a fast-read/write, low-power, non-volatile memory chip needed for storage of critical data for space and missile applications. The program integrates phase-change material (chalcogenide) with semiconductor manufacturing to produce radiation hardened memory chips that will store more than 100 times the amount of data as currently available chips. The technology also shows promise for revolutionary applications (analog and multi-state storage, neural computing) that no other semiconductor technology has shown. The combination of non-volatility, radiation hardness, and truly unique capabilities makes this new electronic technology critical for near-term space applications and enabling for future systems.

Next-Generation Space Processor (NGSP): The NGSP program is developing a general-purpose computer for space based on state-of-the-art commercial processing technology. Two PowerPC-class designs have been transferred to radiation hardened fabrication lines to produce the next generation of space computers. The processors will be more than 20 times more efficient (measured in computations per given amount of power) than current space computers and will be pin-for-pin and software compatible with their commercial equivalents. Based on Reduced Instruction Set (RISC) designs, NGSPs will provide the on-board computing needs for mission processing and much of the data processing from future sensor systems.

Micro-Electromechanical Systems (MEMS): Develop Micro-electromechanical systems (MEMS), associated architectures, and their application to achieve dramatic miniaturization, very low-power electronics, and high-performance architectures. These efforts additionally leverage several space electronics technologies. Specific programs/project collections worked in this focused technology area follow: Highly Integrated Packaging and Processing (HIPP) Program; low-cost 2-D and heterogeneous 3-D packaging; Space Experiments Program; Microsystems and Packaging of Low-power Electronics (MAPLE).

Ultra-High Density Interconnect (UHDI): The long term objective is to develop and qualify electronic packaging improvements in Multi Chip Module (MCM) building blocks, to quadruple density of Space Microsystems packaging. UHDI will demonstrate feasibility of die-optimization, integration of passive components, and improve mixture of signal domains within a single MCM. In addition, UHDI will develop and demonstrate aerospace forms of chip-scale packaging to improve efficiency of board designs in terms of size and weight. Combined packaging and chip-thinning have made it possible to make electronics as thin as a business card. These modules can be stacked so that four modules are now thinner than a single unthinned module. Existing hermetic packages, boards, etc. can be used with a 4X increase in capability over current electronic performance. UHDI can be leveraged into 6.3 programs, especially Space Microsystems Packaging and the Integrated Space Computer Program (ISCP).

CURRENT IMPORTANT PROGRAMS

Counterspace Protection Technologies-PassiveTechniques: The objective of Counterspace Protection Technologies-Passive Techniques is the development and demonstration of passive protection techniques (hardening) to protect US space related capabilities from attack and interference. Multi-threat (including laser, RF/HPM, enhanced radiation, and other advanced weapons concepts) mitigation techniques and performance-compatible survivability enhancement options will be identified, developed and demonstrated consistent with minimum impact on weight/power/cost constraints for high performance mission-critical subsystems. The program includes: 1) development of high fidelity assessment tools for multi-threat environment; 2) assessment of satellite vulnerabilities against current and projected threats; 3) identification of potential passive countermeasures; and 4) development of mitigation techniques. Payoff: endurable mission capability; minimal performance penalty; affordable protection; options supported end states; satellite protection.

Counterspace Protection Technologies-Threat Warning/Attack Reporting: The Counterspace Protection Technologies-Threat Warning/Attack Reporting is developing and demonstrating the essential key technologies for single platform, on-board, satellite threat warning and attack reporting (STW/AR) capabilities. Principal threat environments of concern are those potentially created by radio frequency ground-based sources. A secondary objective is to exercise key CONOPS elements for STW/AR. The STW/AR hardware will detect any radio frequency source tracking or interfering with the operation of the spacecraft. It will geo-locate and characterize the source and report this information to the host spacecraft and subsequently down linked to the ground and sent to the Cheyenne Mountain Complex.

Transmit Receive Antenna Module (TRAM): TRAM is a lightweight, modular, phased array, sub-array antenna concept that is being developed for use in satellite antenna systems, specifically in support of space surveillance and navigation programs. All the antenna RF components are mounted directly on the exposed antenna face. The antenna area density goal, including the supporting antenna structure, for the TRAM antenna is $6kg/m^2$, which represents a 75% reduction over current state-of-the-art antennas. TRAM is one of several experiments aboard the STRV-1d. As such, TRAM operation will be tested in the harsh radiation environment of a GEO transfer orbit.

Electronic Test Bed (ETB) for STRV-1d: The STRV-1d (Space Technology Research Vehicle) is a US/UK satellite sponsored by the Defense Research Agency (DERA) and the Ballistic Missile Defense Organization (BMDO). It will be the secondary payload on an Ariane V launch during 1999. The STRV-1d ETB Data Handling System (DHS) is a general purpose interface between multiple space flight experiments, including TRAM mentioned above, and the spacecraft. The DHS will enable TRAM to ride on any spacecraft of opportunity. The DHS design simplifies some of the complexities to be faced by sub-experimenters, and it provides a simplified interface for operating the space experiment, recording the results, and communicating the results to the spacecraft. It also reduces the risk to the spacecraft mission by providing a degree of separation between the spacecraft and less-proven new technologies, and it provides a similar degree of separation between experiments. The sub-experiments may be mounted on any surface of the STRV-1d spacecraft and will be connected, controlled, and commanded by the DHS.

Improved Space Architecture Concept (ISAC): Program defines and demonstrates an open, distributed and scalable computer architecture for follow-on to Improved Space Computer Program. Program provides a standard electronics subsystem with flexible and robust data and signal processing for a wide variety of demanding, higher-performance applications. An efficient architecture (targeting

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Teraflop performance) minimizes weight and power consumption of the electronics subsystem, while capitalizing on distributed processing and optical interconnect technologies for improved performance. Investigate, develop, and implement methods to adapt and transfer state-of-the-art processors, memories, support components, and architectures to future space processing needs. Invest in projects to support enabling and supporting technologies for revolutionary improvements to space architectures.

Radiation Effects Research Program: The main program emphasis is placed on the experimental and theoretical basic research of radiation-induced effects in microelectronics, the development of novel concepts for electronics, and serving as an independent evaluator of electronics systems for DoD satellite missions. The program goal is to provide DoD with superior electronic technology based on new and innovative design concepts, advanced materials, and advanced manufacturing techniques. As space electronics leverages of the developments made in the commercial industries, the burden within DoD to make electronics failsafe has fallen squarely and solely on the Radiation Effects Research program. This program will respond to this problem by developing advanced high K dielectric gate oxide materials and improve the damage associated with hot electrons. Furthermore, the aim is to provide the Air Force, DoD, NASA and contractors with the most complete selection of radiation simulators within DoD to evaluate and qualify electronic components for the space environment. The program serves as the independent radiation evaluation organization analyzing, for example, electronic components and systems for MMIII, MilSatCom, Adv. EHF, and SMC SBIRS.

Systems Simulation and Control Branch (VSSW)

Modeling and Simulation for Surveillance: Space Surveillance and distributed satellite constellations have a potential role in the future US force structure, based on their capability for all-weather, 24 hour coverage and surveillance of denied areas. The current challenge is modeling space surveillance sensor payloads from a space environment against a variety of targets within diverse clutter backgrounds. AFRL/VS is currently guiding development of varying fidelity simulation models within the Spacecraft Simulation Toolkit (SST) environment being built in the Distributed Architecture Simulation Laboratory (DASL). The models will ultimately predict hyperspectral, dispersive-element sensor imaging and multi-mode RF antenna performance from space across a variety of proposed concept designs for use in military reconnaissance and imaging. For each concept, a preferred method of CONOPS (Concept of Operations) must be developed to answer basic resource allocation requirements. This includes issues such as the command and control options, communication requirements, and data distribution methods for various numbers of satellites within the global constellation. The long-term integrated ability to model a mixed force structure, including other phenomenologies (IR and visible), non-space applications of radar (AWACS, JSTARS), and Fourier Transform Hyperspectral Imaging (FTHSI) is required. Many distinct and necessary pieces for such an integrated analysis exist, but they do not presently work together within a unified simulation environment. AFRL's goal is to help develop modeling and simulation tools to meet all of these needs.

Spacecraft Component Technology Branch (VSSV)

PowerSail: The PowerSail program is an initiative to demonstrate the feasibility of scalable large power generation along with comparable reductions in packaging volume and cost. This is accomplished through a clean-sheet redesign of the power generating sub-system, designing it to take full advantage of the latest advances in structure, photovoltaic, Guidance Navigation and Control, and propulsion technologies. In the basic concept, the traditional solar array is a free flyer that utilizes structures

CURRENT IMPORTANT PROGRAMS

technology developed for solar sails. Current studies show that large thin-film solar arrays will provide dramatic (5-10x) improvement in power system performance and possibly enable future high-power DoD, NASA, and commercial missions. The program held its Phase I final review on 11-12 December 2000 which concludes that concept feasibility study. While significant effort will be required to bring the technology to the operational level, no show-stoppers were identified. The team is planning flight demonstrations of critical technology by 2004. PowerSail is being developed by AFRL/VS in conjunction with the University of Colorado, MIT, Texas A&M University, Virginia Tech, AFRL/PR, AEC Able, Boeing Satellite Systems, Draper, Aerospace, ITN, and LMA.

Precision Controls Group: The Precision Controls Group at AFRL/VS develops and transitions technologies supporting space surveillance and force application missions. The Precision Controls Program includes actuators for high-precision, high-bandwidth real time control, advanced control systems theory and algorithms, and innovative deployment and release mechanisms, spacecraft attitude dynamics and control, and vibration management techniques for large, flexible precision structures.

Integrated Structural Systems Group: The Integrated Structural Systems Group is developing technologies to improve the structures in existing spacecraft and launch vehicles as well as researching highly innovative structural concepts that will enable new spacecraft systems. Current research efforts include technologies to add secondary functionality to primary structure, large space structure concepts, ultra-lightweight mirror structures, and advanced vehicle structures.

Advanced Power Systems Group: The Advanced Power Systems Group is focused on development and demonstration of next-generation space power technologies for advanced space platforms that require increased payload mass and power budgets, along with increased power levels. Technologies under development include ultra-high efficiency crystalline solar cells (25-35%, AM0), ultra-lightweight flexible-thin-film photovoltaics (FTFPV) blankets and solar arrays, and advanced mechanical flywheel and Li-Ion batteries for energy storage.

Space Vehicles Interaction Group: The Space Vehicles Interactions Group investigates and applies technologies that protect valuable payloads during spacecraft launch from vibration and acoustic loading. This protection results in both reduced first day failures and reduced spacecraft mass.

Space Based Infrared Technology Branch (VSSS)

Atmospheric Radiance and Transmission Models: Models of atmospheric transmission and radiance and related databases are in continuous development to expand their spectral domains and to include new or improved representations of atmospheric constituents. The High-resolution Transmission Molecular Absorption Database (HITRAN) is a compilation of spectroscopic parameters that is used by a variety of computer simulation codes to predict the transmission and emission of light in the atmosphere. The Moderate-resolution Transmittance (MODTRAN) Code calculates atmospheric transmittance and radiance for wavelengths from ultra-violet through infrared at moderate spectral resolution. An extension of MODTRAN for hyperspectral imaging applications is the Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes (FLAASH). The Synthetic High-Altitude Radiance Code (SHARC) is the DoD standard for simulating high-altitude (50-300 km) backgrounds at wavelengths from ultraviolet through long-wavelength infrared. An advanced version of SHARC, designated SHARC4, adds atmospheric structure to the radiance description and, in conjunction with the SHARC Image Generator (SIG) code, provides scene generation capability. The Fast Atmospheric Signature Code (FASCODE), a

CURRENT IMPORTANT PROGRAMS

first-principles, line-by-line atmospheric radiance and transmittance code, is the standard benchmark for atmospheric background codes based on band-model approaches to radiation transport. FASCODE is applicable from the visible to long-wavelength infrared and is generally used to calculate atmospheric radiance and path transmission at low altitudes; it can be used for non-equilibrium high-altitude calculations if supplied with the appropriate vibrational-level temperatures. The Moderate Spectral Atmospheric Radiance and Transmittance Code (MOSART) is a unified and seamless code for calculating atmospheric transmission and radiance in the ultraviolet through microwave spectral region at low altitudes for line-of-sight paths within the atmosphere and for paths which intersect the Earth's surface. SHARC and MODTRAN Merged (SAMM) is a recently developed code that provides seamless coverage of radiance and transmittance over the entire altitude range from the Earth's surface to 300 km.

Background Clutter Mitigation: Models to specify and predict background clutter are being developed from data acquired by airborne and space based sensors. The data span the short-, medium-, and long-wavelength infrared and include a wide variety of background scenes and global clutter statistics. Models are developed using these data together with laboratory measurements and theory. The data and models support the design of the Space-Based Infrared System (SBIRS) by SMC and the design of theater missile defense and national missile defense systems by BMDO.

Midcourse Space Experiment (MSX): The MSX program was established by the Ballistic Missile Defense Organization as a functional demonstration of target detection and as a background measurements program. The MSX Earth Limb and Terrestrial Backgrounds Team in the Space Vehicles Directorate generated a series of well-documented reference scenes of infrared backgrounds of unprecedented quality to the SBIRS community to assist in the design of the next-generation infrared (IR) surveillance systems. The MSX measurements include the first infrared observations of several atmospheric phenomena that present newly identified sources of background clutter. These include atmospheric gravity waves, stratospheric warming, and polar mesospheric clouds. The MSX data provide the first definitive measurements of infrared backgrounds at the spatial scales, sensitivity and wavelengths needed to support both current and future requirements for theater and national missile defense.

Polarimetry Program: The purpose of the program is to develop polarimetry techniques that have the promise of detecting and identifying man-made and natural objects from long standoff ranges with little or no thermal contrast. Technology developed under this program will provide autonomous detection and identification of military targets for reconnaissance and surveillance missions, which allows for more area to be covered by these sensors than conventional imagery systems. In addition, technology developed under this effort allows for the detection and identification of targets that were previously undetectable by conventional imaging systems. Examples include camouflaged targets, underground and concealed targets, and terrain features for trafficability analysis. Successful field experiments were done in FY99 evaluating a LWIR instrument for measuring polarimetric signatures. These experiments showed excellent contrast between man-made and natural objects.

35/60K Protoflight Cryocooler: This BMDO and Space Based Infrared System (SBIRS) Low co-sponsored program is designed to produce a prototype multi-load Stirling, Brayton, and pulse tube cycle cryocoolers capable of providing simultaneous cooling of MWIR and LWIR sensors at 35 and 60 K. This technology is considered a technology option for the SBIRS Low EMD system. Two programs are being funded to address the SBIRS Low program objectives. A joint program through NASA/GSFC leverages previous development efforts with Ball Aerospace Corporation in developing a Stirling cycle

CURRENT IMPORTANT PROGRAMS

cryocooler for operation at 30K. Utilizing the compressor design of the 30K program, Ball developed a unique three-stage cryocooler providing two simultaneous cooling loads (0.4W at 35K and 0.6W at 60K).

Development of Advanced Very Long Wavelength Infrared Detectors (DAVID): Development of FPA technology and fabrication methodology required to produce cost effective and high performance FPA meeting space based LWIR missile tracking requirements for Nuclear Missile Defense. The Development of Advanced Very Long Wavelength Infrared Detectors (DAVID) program, is working to advance strategic long wavelength infrared (LWIR) focal plane array (FPA) sensitivity, operability, uniformity, dynamic range, cut-off wavelength, and radiation hardness. DAVID is improving FPA radiation hardness extending the cut-off wavelength from 11.5 um to 14 um, while keeping the same 40K operating temperature and a comparable sensitivity specification. This extended cut-off wavelength is required to detect and track post-boost inter-continental ballistic missiles during their trajectory outside the Earth's atmosphere. This program is designed to support the SBIRS Low by providing them the technology required for both National and Theater Ballistic Missile Defense.

EQUIPMENT/FACILITIES

Primary operating locations are: Kirtland AFB, NM and Hanscom AFB, MA.

Secondary locations are at Edwards AFB, CA; Holloman AFB, NM; Sunspot, NM; and Gakona,AK.

Unique facilities at Kirtland AFB NM include: The Space Structures/Composites Laboratory, the Aerospace Engineering Facility (AEF), the Space Assembly and Integration Facility (SAITF), Power and Thermal laboratory, Dynamitron facility, Cobalt 60 facility, and Nuclear Engineering evaluation facility.

Unique facilities at Hanscom AFB, MA include: The High Resolution Spectroscopy facility, Cold Chemiexcited Infrared Simulation Experiment (COCHI SE), Laboratory Cryogenic Electron Dependent Emissions (LABCEDE), Selected Ion Flow Drift Tube (SIFDT), Air Force Interactive Meterological System (AIMS), Electron/Ion and Thermal Calibration Facility (MUMBO and JUMBO), Mass Spectrometer Calibration System, and High Altitude Light Detection and Ranging (LIDAR) Sounder.

At Edwards AFB, CA: The National Hover Test Facility (NHTF).
At Gakona, AK: The High Frequency Active Auroral Research Program (HAARP) facility.
At Sunspot, NM: Shared use of the National Solar Observatory (owned by NSF).
At Holloman, NM: The high altitude balloon launch facility.

Space Vehicles Directorate
Kirtland AFB, NM 87117-5776
(505) 846-6243

Director: Christine M. Anderson
Deputy Director: Col Richard A. Kniseley

FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	4.674	0.271	5.238	10.183
6.2	7.792	16.473	34.149	58.414
6.3	9.616	4.288	116.005	129.909
Subtotal (S&T)	**22.082**	**21.032**	**155.392**	**198.506**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.096	28.847	28.943
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	1.709	0.000	21.828	23.537
TOTAL RDT&E	**23.791**	**21.128**	**206.067**	**250.986**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	3.005	N/A	36.449	39.454
TOTAL FUNDING	**26.796**	**21.128**	**242.516**	**290.440**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	9	67	54	130
CIVILIAN	90	136	226	452
TOTAL	**99**	**203**	**280**	**582**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	237.000	**REAL PROPERTY**	153.000
ADMIN	67.000	* NEW CAPITAL EQUIPMENT	0.000
OTHER	450.000	**EQUIPMENT**	364.000
TOTAL	**754.000**	* NEW SCIENTIFIC & ENG. EQUIP.	0.000
ACRES	**5787**	* Subset of previous category.	

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

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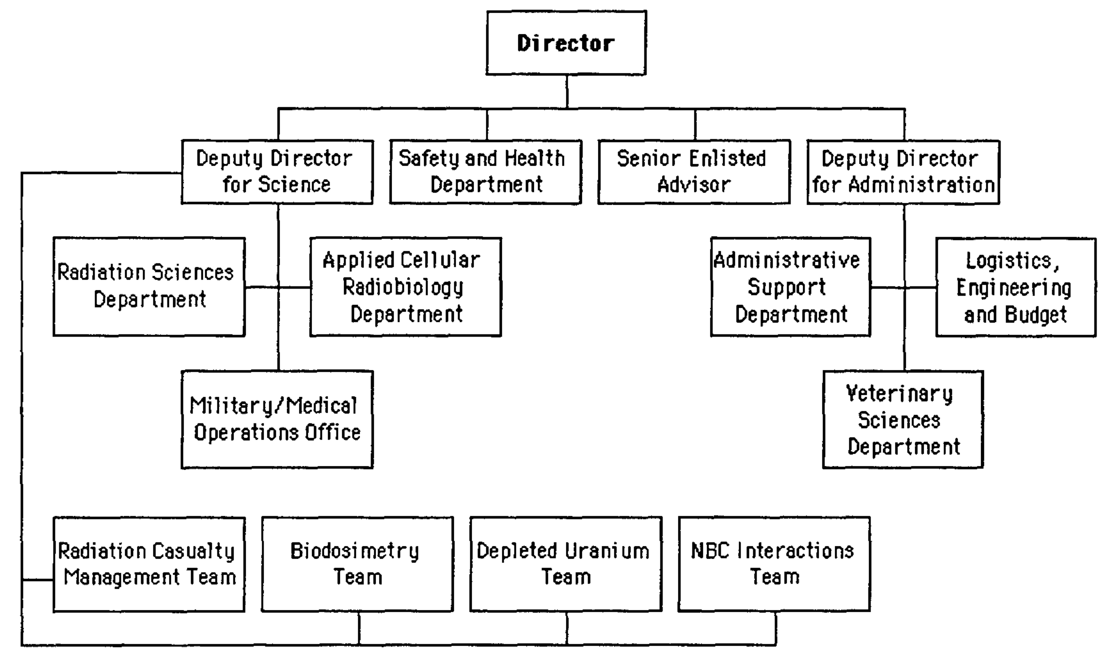
UNIFORMED SERVICES UNIVERSITY of the HEALTH SCIENCES (USUHS)

The only In-House RDT&E Activity within USUHS is the Armed Forces Radiobiology Research Institute (AFRRI).

Armed Forces Radiobiology Research Institute

FY2000 Abbreviated Functional Chart - Technical Organizations



Armed Forces Radiobiology Research Institute
Bethesda, MD 20889-5603
(301) 295-1210
Director: COL Robert R. Eng, MS, USA
Deputy Director: LTCOL Ronald E. Palmer, USAF

MISSION

The mission of the Armed Forces Radiobiology Research Institute is to conduct research in the field of radiobiology and related matters essential to the operational and medical support of the Department of Defense and military services.

CURRENT IMPORTANT PROGRAMS

Develop medical countermeasures to treat radiation injuries.

Add Quantitatively define medical effects of combined exposure to radiation and chemical or biological agents.

Development of reliable biodosimetry assays/techniques.

Optimize combinations of protective agents to promote survival and combat effectiveness following irradiation at high or low doses.

Evaluation of early and late effects of radiation exposures at low dose rates.

Impact of imbedded depleted uranium shrapnel on biological systems.

Continue to support studies of residents of the former Soviet Union who were exposed to chronic radiation through environmental contamination.

EQUIPMENT/FACILITIES

Functions: Operate facilities for conducting radiobiology research and disseminating results, conduct advanced training, provide analysis consultation on bioeffects of radiation and perform other research functions as required. Major equipment includes TRIGA Mark-F moveable-core pool type reactor to operate in pulse and steady state modes, 73,000 curie cobalt-60 facility permitting either unilateral or bilateral exposures, 100 curie cobalt-60 panoramic irradiator with retractable source, 54MeV linear accelerator, 320 kVp industrial x-ray machine. Support services include measurement of irradiation fields, provision and care of laboratory animals, real-time data acquisition system, television and film documentation of experiments, personnel and environmental monitoring, and editorial assistance in report preparation.

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FY2000 FUNDING DATA (MILLIONS $)				
APPROPRIATION	**IN-HOUSE**	**IN-HOUSE MANAGEMENT**	**OUT-OF-HOUSE**	**TOTAL**
RDT&E:				
6.1 ILIR	0.000	N/A	N/A	0.000
6.1 Other	0.000	0.000	0.000	0.000
6.2	8.608	0.000	0.000	8.608
6.3	1.986	0.000	0.000	1.986
Subtotal (S&T)	**10.594**	**0.000**	**0.000**	**10.594**
6.4	0.000	0.000	0.000	0.000
6.5	0.000	0.000	0.000	0.000
6.6	0.000	0.000	0.000	0.000
6.7	0.000	0.000	0.000	0.000
Non-DOD	0.000	0.000	0.000	0.000
TOTAL RDT&E	**10.594**	**0.000**	**0.000**	**10.594**
Procurement	0.000	N/A	0.000	0.000
Operations & Maintenance	0.000	N/A	0.000	0.000
Other	1.253	N/A	0.000	1.253
TOTAL FUNDING	**11.847**	**0.000**	**0.000**	**11.847**

MILITARY CONSTRUCTION (MILLIONS $)	
Military Construction (MILCON)	0.000

PERSONNEL DATA (END OF FISCAL YEAR 2000)				
	SCIENTISTS & ENGINEERS		**TECHNICAL SUPPORT & OTHER PERSONNEL**	
TYPE	**DOCTORATES**	**OTHER**		**END STRENGTH**
MILITARY	0	0	48	**48**
CIVILIAN	16	18	39	**73**
TOTAL	**16**	**18**	**87**	**121**

SPACE AND PROPERTY			
BUILDING SPACE (THOUSANDS OF SQ FT)		**PROPERTY ACQUISITION COST (MILLIONS $)**	
LAB	61.750	REAL PROPERTY	18.610
ADMIN	34.257	* NEW CAPITAL EQUIPMENT	0.000
OTHER	77.235	**EQUIPMENT**	10.708
TOTAL	**173.242**	* NEW SCIENTIFIC & ENG. EQUIP.	0.082
ACRES	**10**	* Subset of previous category.	

APPENDICES

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APPENDIX A
DISESTABLISHMENT, ESTABLISHMENT, OR CHANGE IN ORGANIZATION NAME

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APPENDIX A

DISESTABLISHMENT, ESTABLISHMENT, OR CHANGES IN ORGANIZATION NAME BETWEEN FY1999 AND FY2000

DEPARTMENT OF THE ARMY

The **Aviation Research, Development and Engineering Center** and **Missile Research, Development and Engineering Center** merged and their data is now reported as part of the *Aviation and Missile Research and Development Center.*

The **Operational Test and Evaluation Command (OPTEC)** is now the Army Test and Evaluation Command (ATEC). ATEC individual subordinate activity data is published in the report as follows:

Army Evaluation Center.

Headquarters, Development Test Command and the following component Activities (which were previously components of the Army Materiel Command):

Aberdeen Test Center
Aviation Technical Test Center
Dugway Proving Ground
Redstone Technical Test Center
White Sands Missile Range
Yuma Proving Ground

Operational Test Command.

DEPARTMENT OF THE NAVY

The **Navy Personnel Research and Development Center (NPRDC)**, San Diego was disestablished in November 1999 as a result of BRAC IV. The Center's training research mission was realigned under the Naval Air Warfare Center Training Systems Division (NAWCTSD), Orlando, FL in FY1998 and the manpower and personnel R&D functions were realigned under the Navy Personnel Command (NPC), Millington, TN in November 1999.

The four Naval warfare centers provide full spectrum research, development, test and evaluation, engineering, and fleet support services and perform a substantial amount of non-RDT&E work. Prior to FY1998, the Navy reported each warfare center in its entirety, even though a considerable amount of the reported end strengths, funding, and other resources were devoted to other than RDT&E programs. For purposes of more accurately reflecting RDT&E In-House resources in this report, the Navy has applied the established RDT&E In-House criteria (i.e., a minimum of 25% of total funds is RDT&E and a minimum of 25% of in-house effort is devoted to RDT&E) at the division or major site level rather than reporting all warfare center sites, regardless of their level of RDT&E work. As a result, some warfare center entities have been eliminated from this report because they are below the 25% RDT&E threshold for inclusion in this report:

- The **Naval Air Warfare Center** does not include data from the Aircraft Division Lakehurst Activity and Training Systems Division.
- The **Naval Surface Warfare Center** does not include data from the Crane and Port Hueneme Divisions and NWAS Corona.
- The **Naval Undersea Warfare Center** does not include data from the Keyport Division.
- The **Space and Naval Warfare Systems Centers** do not include data from SSC, Charleston and SSC, Chesapeake.

APPENDIX A

DISESTABLISHMENT, ESTABLISHMENT, OR CHANGES IN ORGANIZATION NAME
BETWEEN FY1999 AND FY2000

DEPARTMENT OF THE AIR FORCE

At the beginning of FY1999, the Air Force Development Test Center (AFDTC) was abolished and the **Air Armament Center** was created. This transition changed the organization from a Development Test Center to an Acquisition Product Center. With this change, **Air Armament Center** (AAC) became a predominantly O&M funded operation except for those functions associated with test and evaluation activities conducted in the *46th Test Wing*. Based on this change the **Air Armament Center's** *46th Test Wing* data is reported for FY2000.

DEPARTMENT OF DEFENSE AGENCIES

No changes.

Note: Activities in **bold typeface** were reported in the FY1999 edition of this report as separate Activities.

Italicized Activities are new for FY2000.

APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

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APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

INTRODUCTORY PRECAUTIONARY NOTE

Data in this report should not be summarized or used for comparative analyses between Activities and/or across Services because labs/centers use different business systems to satisfy their special needs. Organizational structures also differ. Some organizations (e.g., Navy) operate on an industrial funding basis; that is, they charge their customers for all operating costs, including maintaining their physical plants and providing other necessary support services (e.g., human resources office, finance and accounting support). Other labs/centers (e.g., Army/Air Force) are institutionally funded; that is, they receive most of their funding as direct appropriations from Congress and use these funds for operating support costs as well as for research. Institutionally funded labs/centers may be tenants on larger military bases and receive their support services from those host bases, or they may be responsible for base operations and these support services (personnel and costs). Both are included in this report, as appropriate.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

ABBREVIATED FUNCTIONAL CHART - TECHNICAL ORGANIZATIONS

This is a partial organization chart, provided by each Activity, to provide an overview of its technical operations. It does not depict the entire organizational structure and is abbreviated for purposes of this report.

NARRATIVES

Mission Statement
Stated is the mission of the laboratory or Activity.

Current Important Programs
Summarized are current important programs on which the laboratory or Activity is working. Any Technology Transition efforts like Cooperative Research and Development Agreements (CRADAs) are identified.

- **Technology Transfer**
  Data supplied are any major Technology Transfer efforts underway, including the number of scientists and engineers exchanged with industry or academia.

Equipment/Facilities
Summarized are the major equipment and facility capabilities of the laboratory or Activity including any unique equipment and facilities not available to the commercial or academic R&D community anywhere else.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING

RDT&E Budget Activities (BAs)

BA	BA Title	Applicable Research Categories
1	Basic Research	6.1
2	Applied Research	6.2
3	Advanced Technology Development	6.3
4	Demonstration and Validation (Dem/Val)	6.4
5	Engineering & Manufacturing Development (EMD)	6.5
6	RDT&E Management Support	6.6
7	Operational Systems Development (OSD)	6.7

In-House RDT&E Activities
These Activities are organizational entities which perform at least 25% of their work in any or all of the categories of research, development, test and evaluation (RDT&E). In addition, at least 25% of an Activity's In-House manpower and/or 25% of the obligation authority used In-House is devoted to one or more of the categories of RDT&E.

Current Year Obligation Authority
Authority for the financial resources available for obligation in the specific year being reported. This excludes unobligated authority carried forward from the prior year. The appropriation category refers to the original funding source, even if it may reimburse a different funding category.

In-House
The total amount for the fiscal year reporting period for mission-oriented work directly performed, or to be performed by government personnel of the reporting organization.

- **Included**: Funding regardless of source (i.e., own Service, sister Service, ARPA, OSD, etc.); costs of supplies and equipment essentially of an off-the-shelf nature, which are procured for use in-house; direct labor, direct material, direct travel, direct equipment, direct computer support, other direct support; and all overhead costs.
- **Excluded**: Expenses for planning and administering contracts and grants for out-of-house work and expenses for activities performed by contractors of the reporting organization.

In-House Managing Out-of-House
The total amount of funds incurred in planning and administering out-of-house programs by personnel of the reporting organization. **(This data element is not applicable for the Navy. The Navy includes these funds in the In-House category).**

- **Included**: Travel and other supporting services.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

Out-of-House
The total amount for the fiscal year reporting period for direct mission-oriented work performed, or to be performed, by other than the government personnel at the reporting organization.

- **Included**: RDT&E work by other departmental or DoD organizations, industrial firms, educational institutions, not-for-profit institutions, and private individuals.
- **Excluded**: All overhead costs.

<u>6.1 Basic Research</u>

6.1 In-House Laboratory Independent Research (ILIR)
The total amount for research 6.1 In-House Laboratory Independent Research program elements.

6.1 Other In-House/Out-of-House
The total amount for Basic Research 6.1 program elements which are not ILIR but are conducted in-house/out-of-house.

6.1 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Basic Research 6.1 programs by personnel of the organizational entity, which are conducted out-of-house.

<u>6.2 Applied Research</u>

6.2 In-House/Out-of-House
The total amount for Applied Research 6.2 program elements conducted in-house/out-of-house.

6.2 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Applied Research 6.2 programs by personnel of the organizational entity, which are conducted out-of-house.

<u>6.3 Advanced Technology Development</u>

6.3 In-House/Out-of-House
The total amount for Advanced Technology Development 6.3 program elements conducted in-house/out-of-house.

6.3 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Advanced Development 6.3 programs by personnel of the organizational entity, which are conducted out-of-house.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

6.4 Demonstration and Validation (Dem/Val)

6.4 In-House/Out-of-House
The total amount for Dem/Val 6.4 program elements conducted in-house/out-of-house.

6.4 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Dem/Val 6.4 programs by personnel of the organizational entity, which are conducted out-of-house.

6.5 Engineering and Manufacturing Development (EMD)

6.5 In-House/Out-of-House
The total amount for EMD 6.5 program elements conducted in-house/out-of-house.

6.5 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Engineering and Manufacturing Development 6.5 programs by personnel of the organizational entity, which are conducted out-of-house.

6.6 RDT&E Management Support

6.6 In-House/Out-of-House
The total amount for RDT&E Management Support 6.6 program elements conducted in-house/out-of-house.

6.6 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Management Support 6.6 programs by personnel of the organizational entity, which are conducted out-of-house.

6.7 Operational Systems Development (OSD)

6.7 In-House/Out-of-House
The total amount for all OSD 6.7 with RDT&E funds conducted in-house/out-of-house. This item is interpreted in its broadest sense to include operational developments outside the systems areas, and not included in any of the above categories.

6.7 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering OSD 6.7 programs by personnel of the organizational entity, which are conducted out-of-house.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

<u>Non-DoD</u>

Non-DoD In-House/Out-of-House
The total amount for all In-House/Out-of-House RDT&E not included in 6.1-6.7 as defined above.

Non-DoD In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering RDT&E not included in 6.1-6.7 programs, by personnel of the organizational entity, which are conducted out-of-house

<u>Procurement</u>

Procurement In-House/Out-of-House
The total amount for procurement appropriations in-house/out-of-house regardless of source.

<u>Operation and Maintenance (O&M)</u>

O&M In-House/Out-of-House
The total amount for O&M appropriations in-house/out-of-house regardless of source.

<u>Other</u>

Other In-House/Out-of-House
The total amount for all other appropriations in-house/out-of-house regardless of source.

- **Included**: Military Pay and Allowances (MPA) if applicable, *for Activities not under the Working Capital Fund. Military Pay & Allowances at Working Capital Fund Activities are reflected in each funding category (e.g., 6.1, 6.2, etc.) shown in the report.*

<u>Military Construction (MILCON)</u>

MILCON
This is the total amount for Military Construction appropriations.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

Totals

Total RDT&E
The sum of the total amount, regardless of source, for both In-House, In-House Managing Out-of-House, and Out-of-House funding for the following categories:

ILIR	6.1
Basic Research	6.1
Applied Research	6.2
Advanced Technology Development	6.3
Demonstration and Validation (Dem/Val)	6.4
Engineering and Manufacturing Development (EMD)	6.5
RDT&E Management Support	6.6
Operational Systems Development	6.7
Non-DOD	

Total Funding
The sum of Total RDT&E, Procurement, Operations & Maintenance and Other.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

PERSONNEL

<u>Military</u>

Military End Strength
Military end strength is the September 30 *On-Board* strength of Active duty military
- **Included**: Transients, trainees, holdees and students.
- **Excluded**: Cadets.

Military Scientist and Engineering Doctorates
The total number of military scientists and engineers (officer and enlisted) whose most advanced degree is a doctorate. Degrees must be earned from an accredited college or university. Honorary degrees are excluded.
- **Included**: Full-time military scientific, engineering, mathematical, and medical personnel actively engaged in RDT&E activities.
- **Excluded**: Lawyers, accountants, chaplains, social workers and educators.

Other Military Scientists and Engineers
The total number of military scientists and engineers (officer and enlisted) who do not hold a doctor's degree, but who are considered professionals.
- **Included**: Full-time military scientific and engineering personnel actively engaged in RDT&E activities.
- **Excluded**: Lawyers, accountants, chaplains, social workers and educators.

Military Technical Support and Other Personnel
The total number of Military Technical Support and Other Personnel. This includes all military personnel not listed in the above two categories.

<u>Civilian</u>

Civilian End Strength
Civilian end strength is the September 30 *On-Board* strength of DoD civilian direct hires in a paid, active duty status who are paid from appropriated funds (RDT&E and other appropriations).
- **Included**: Part-time and temporary personnel.
- **Excluded**: Defense Intelligence Agency and National Security Agency personnel.

Civilian Scientist and Engineering Doctorates
The total number of civilian scientists and engineers whose most advanced degree is a doctorate. Degrees must be earned from an accredited college or university. Honorary degrees are excluded.
- **Included**: Full-time government scientific, engineering, mathematical, and medical personnel actively engaged in RDT&E activities.
- **Excluded**: Lawyers, accountants, chaplains, social workers and educators.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

PERSONNEL (continued)

Other Civilian Scientists and Engineers
The total number of civilian scientists and engineers who do not hold a doctor's degree, but who are rated as professionals.

- **Included**: Full-time government scientific and engineering personnel actively engaged in RDT&E activities.
- **Excluded**: Lawyers, accountants, chaplains, social workers and educators.

Civilian Technical Support and Other Personnel
The total number of Civilian Technical Support and Other Personnel. This includes all civilian personnel not listed in the above two categories.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

SPACE AND PROPERTY

Acreage
The total number of acres owned, combined with the total number of acres occupied, rounded to the nearest acre. In cases involving tenants who are also RDT&E Activities, the tenants report only the acreage occupied solely by them. The owning Activity reports the remainder including any acreage occupied by non-R&D tenants.

- **Included**: Land which is public domain.
- **Excluded**: All easements and permits.

Laboratory Space
The total number of square feet (in thousands)* of permanent and semi-permanent (e.g., fixed-site trailers) building space that is laboratory space.

- **Included**: Only walled and roofed building space; facilities assigned to, leased by, or occupied by the reporting organization.
- **Excluded**: Parking lots; open storage areas; lean-tos.

Administrative Space
The total number of square feet (in thousands)* of building space that is administrative space (usually that portion occupied by the headquarters and support services staff).

- **Included**: Facilities assigned to, leased by, or occupied by the reporting organization.
- **Excluded**: Scientists' or engineers' offices in a laboratory which is reported as Laboratory Space.

Other Space
The total number of square feet (in thousands)* of all remaining building space (e.g., hangars, warehouses, garages, etc.).

- **Included**: Facilities assigned to, leased by, or occupied by the reporting organization.

**Square feet is expressed in thousands. For example, 15,200 square feet is entered as 15.2.*

Acquisition Cost of Real Property
The total acquisition cost (in millions $)** of all land, buildings, and capital equipment and their improvements. An RDT&E owner does not report this information for the facilities assigned to, or occupied by its RDT&E tenants, as they report this information separately.

- **Included**: The cost of installed physical plant equipment, such as HVAC; facilities assigned to, leased by, or occupied by the reporting organization.
- **Excluded**: The cost of acreage or buildings rented from private owners.

Each reporting activity is responsible for determining and reporting the cost of real property. This includes the cost of installed equipment. This figure represents the true total investment over the life of the activity for real property on hand as of the reporting date.

APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

SPACE AND PROPERTY (continued)

New Capital Equipment
The total acquisition cost (in millions $)** for new capital equipment (i.e., installed physical plant equipment such as HVAC) acquired during the fiscal year reporting period. This amount is also included in the entry for Acquisition Cost of Real Property.

Acquisition Cost of Equipment
The total acquisition cost (in millions $)** of all "personal property" equipment. An RDT&E owner does not report this information for the facilities assigned to, or occupied by its RDT&E tenants, as they report this information separately.

- **Included**: The cost of installed equipment directly related to mission execution, such as lab test equipment; the cost of equipment in facilities assigned to, leased by, or occupied by the reporting organization.
- **Excluded**: The cost of physical plant equipment reported under Acquisition Cost of Real Property (explained previously).

Each reporting activity is responsible for determining and reporting the cost of personal property. This cost includes those costs incurred by the acquisition (including installation when applicable) of all property other than real property. It includes personal property such as machine tools, environmental test equipment, furniture, laboratory equipment, vehicles, etc. Items having a unit cost of less than $200 are excluded. The figure represents the cost of all personal property acquired throughout the life of the activity, to the reporting date, that is still on hand.

New Scientific & Engineering Equipment
The total acquisition cost (in millions $)** for new scientific and engineering equipment acquired during the fiscal year reporting period. This amount is also included in the entry for Acquisition Cost of Equipment.

- **Included**: The cost of installed equipment directly related to mission execution, such as lab test equipment.

*** Dollars are expressed in millions rounded to the nearest thousand. For example, $2,517,830 is entered as 2.518.*

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APPENDIX C
SELECTED STANDARD ABBREVIATIONS AND ACRONYMS

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APPENDIX C

SELECTED STANDARD ABBREVIATIONS AND ACRONYMS

ACTD	-	Advanced Concept and Technology Demonstration
ASW	-	Antisubmarine Warfare
ATD	-	Advanced Technology Demonstration
C2	-	Command and Control
C4I	-	Command, Control, Communications, Computers, and Intelligence
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
CAM	-	Computer Aided Manufacturing
CB	-	Chemical Biological
CBR	-	Chemical, Biological, Radiological
CM	-	Countermeasures
CONUS	-	Continental United States
COTS	-	Commercial off-the Shelf
CRADA	-	Cooperative Research and Development Agreement
CW	-	Chemical Warfare
DoD	-	Department of Defense
ECM	-	Electronic Countermeasures
EMI	-	Electromagnetic Interference
EMP	-	Electromagnetic Propagation
EPA	-	Environmental Protection Agency
EW	-	Electronic Warfare
GPS	-	Global Positioning System
HF	-	High-Frequency
HVAC	-	Heating, Ventilation, and Air Conditioning
IFF	-	Identification, Friend or Foe
ILIR	-	In-House Laboratory Independent Research
IR	-	Infrared
KE	-	Kinetic Energy
LAN	-	Local Area Network
M&S	-	Modeling and Simulation
MOUT	-	Military Operations in Urban Terrain
MSRC	-	Major Shared Resource Center
NBC	-	Nuclear, Biological and Chemical
NVD	-	Night Vision Devices
OCONUS	-	Outside the Continental United States
PEO	-	Program Executive Officer
PM	-	Program Manager
R&D	-	Research and Development
RDT&E	-	Research, Development, Test and Evaluation
RF	-	Radio Frequency
SOF	-	Special Operations Forces
S&T	-	Science and Technology
SBIR	-	Small Business Innovation Research
STO	-	Science and Technology Objective
T&E	-	Test and Evaluation
UAV	-	Unmanned Aerial Vehicle
USW	-	Undersea Warfare
UUV	-	Unmanned Undersea Vehicle
UV	-	Ultraviolet

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